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MAGAZINE

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THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOL. 17 NO. 7 APRIL 7, 1998

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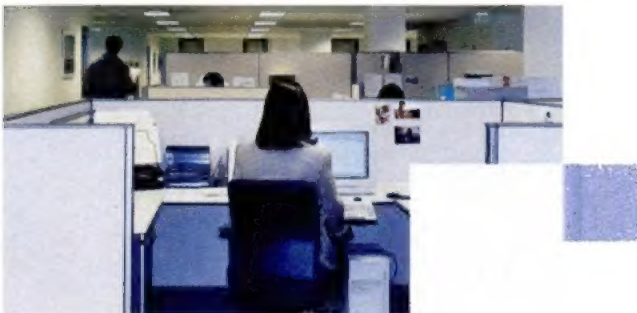
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Why Java Still Matters



Java is the fastest-growing computer language that any of us have ever seen; it continually attracts new programmers, and applications written in the language and for the Java environment are being introduced at a faster pace. But Java doesn't have people talking about it as much as they did a year ago.

Some predicted that soon every Web page would contain some Java. Others contended that it wouldn't be long until Java challenged Windows as a computing environment. Those things now seem unlikely, or at least a long way from happening. So why is *PC Magazine* devoting most of this issue to Java?

The answer is simple: Because Java still matters. Java matters because it offers the potential of a real cross-platform environment. And Java matters because it offers the best chance yet to move to a more modern style of programming.

Java hasn't yet succeeded, as some hoped, simply because it isn't all it was once cracked up to be. The promise of "write once, run everywhere" is still not a reality. During our evaluation of Java virtual machines, PC Labs tested for applications compatibility across various Java environments. We found no "100% Pure Java" environment that ran all of our test apps. And despite Sun's complaints about Microsoft, the problem doesn't appear to have much to do with Microsoft's interpretation of Java. In fact, Microsoft Internet Explorer 4 was among the best-behaved of the virtual machines we've seen.

In addition, the Java applications we tested so far haven't yet been as good as we'd like to see them, although some were quite impressive. In fact, I've been more impressed by some prerelease Java apps.

In many respects, the most advanced part of Java is its status as a development tool. For years, programmers have been looking for an object-oriented system in which they could easily pull together a variety of little components and tailor the logic around them to create customized applications. The development tools we look at show that this is becoming a reality faster with Java than with any other platform. Although Visual Basic and ActiveX

controls have been around for some time, JavaBeans seem to work better as building blocks for more complex apps.

We also looked at a host of smaller applet creation tools—those designed to create programs that run only within a Web browser—that give such building blocks to end users. A lot of Visual Basic components are out there, but the applications for pulling them all together

are not nearly as transparent to the developer and user.

All that pales in comparison with the primary hoped-for benefit of the Java environment: that an application can run on any system with a Java virtual machine, without the developer knowing anything else about the system.

It isn't that Java will replace Windows. Even the most ardent critics of Windows know it will be the most popular desktop environment for years to come. But Java offers the promise of getting applications to work without requiring complex installation procedures or knowledge about how the machine is configured or what other apps are installed. All a developer would need to know is that the Java VM is present. As our Labs tests show, this isn't yet a reality, but it's closer to one with Java than with Windows.

Why is this important? HTML and forms may be enough for just selling products on the Internet, but if we need more complex software to tie together firms in an "extranet" situation, we'll need more. And Java is the best chance I see to get applications that work well enough in every environment to enable this kind of electronic commerce.

Java remains more than just another programming language. It represents a move toward a more advanced way of programming—one that is particularly suitable for helping firms work together. It is an environment that all of us need to understand if we care about where computing is going.


MICHAEL J. MILLER

Imagine

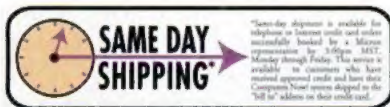
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your guide to

JAVA

for

1998

BY JOHN CLYMAN

Whether the Java wave has actually hit your office yet we don't know (you might have thought it was El Niño), but we know it will in

some form. You want to be ready for it, especially if you've already been asking yourself, "Do I need to think about using Java in my business?" Fortunately, we've been pondering this question too, and here's our latest take on this technology. We begin with an overview of Java's significance, what Java really is (and isn't), and what it can do for you. Next we've got four separate [Labs-based comparative reviews of Java products to help you choose the best place to jump in right now](#)101

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Online Java Guide

Our Java coverage continues online, where you can test the performance of your own Java VM with our new JMark 2.0 benchmark tests. You'll find them at the Virtual Labs at www.virtual-labs.com. And don't miss JavaUser, ZDNet's ultimate guide to everything about the language. It's at www.zdnet.com/products/javauser.htm.

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BY LARRY SELTZER

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BY LARRY SELTZER

You need to run software called a Java environment—or virtual machine (VM)—on any computer where you want to run Java applications or applets. We report on Java VMs from six different vendors across five different operating systems137



AFTER HOURS

Start Your Engines!

BY T. LIAM MCDONALD
If normal driving isn't challenging enough for you these days, you're crazy. But you're also in luck. We took seven of the latest racing simulators out to

JAVA GUIDE

Applet Tools

BY GREG ALWANG

One of Java's first real success stories is as the technology behind many of those great little interactive areas at your favorite Web sites. We test seven applet creation tools to help you set your Web site apart. Most require no coding163

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JAVA GUIDE

Development Packages

BY RICHARD V. DRAGAN

In this, our second roundup of Java development tools, we find the professional-level packages maturing nicely. It's no easy job for the creators of these packages, keeping up with emerging Java standards and technologies—such as JavaBeans and new JDK versions—while maintaining ease of use in a RAD world181

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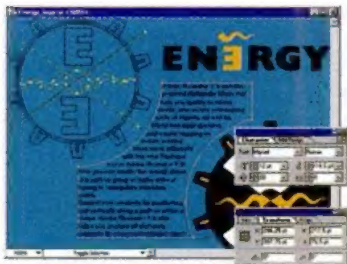
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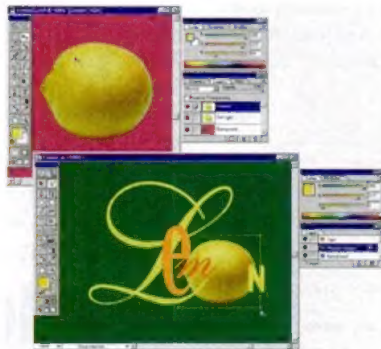
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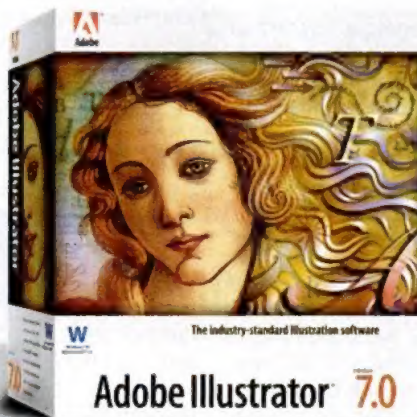
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Pipeline

Tech Toys

It's spring, and toy manufacturers are getting serious about rallying excitement for high-tech toys slated to debut this fall. At the recent International Toy Fair in New York

deal a deck of cards, or dispense candies.

The nervous system of a Mindstorms robot is controlled by the RCX, a "smart brick"—consisting of an 8-bit processor, a proprietary OS, and 16K of memory—that takes input from touch and light sensors to drive its motors.

Using an infrared transmitter, kids can download five programs (each with up to 1,500 instructions) from the included CD-ROM or write their own with RCX Code. Powered by six AA batteries, a robot can then move about and "think."

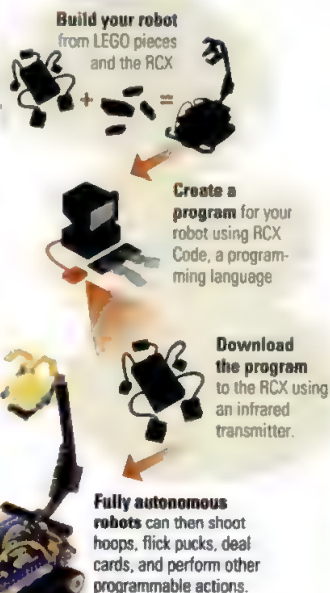
Available this September, the kit includes



The RCX "smart brick" has a programmable 16-bit chip and serves as the brain of LEGO Mindstorms inventions.

City, LEGO—the Danish company famous for inventing interlocking plastic bricks—took center stage with the Mindstorms Robotics Invention System (\$200), an innovative kit that implants a microchip in the popular plastic bricks.

Born from 13 years of research and collaboration with MIT's Media Lab, Mindstorms draws on advanced robotics techniques used for such serious work as handling hazardous waste and controlling the Mars Pathfinder. A Mindstorms invention can be programmed to shoot hoops, pick up soda cans, duck into dark corners, become a light-sensitive intruder alarm,



the RCX, an infrared transmitter, 700 LEGO pieces, a construction guide, and building components, including light and touch sensors, motors, and gears. Three expansion packs—Exploration Mars, Extreme Creatures, and RoboSports—will work with an optional digital video camera.

Over 82 Million Served

The 1997 year-end market share numbers for PC manufacturers have rolled in. And despite economic turmoil in Asia, the global market increased by nearly 16 percent in 1997 over 1996, with PC shipments surpassing 82 million.

Numbers from market research firm Dataquest show that the PC shipments of three top vendors—Compaq Computer, Dell, and

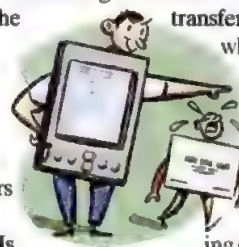


Hewlett-Packard—increased by over 40 percent. "1997 witnessed the continuous consolidation of market presence by an elite few PC manufacturers," says Bill Schaub, a Dataquest vice president. He adds, "During the course of 1997, the top four manufacturers captured almost 70 percent of PC unit growth worldwide."

Palm-to-Palm

Trading business cards may soon be totally passé. Beaming them is more like it. The Palm III, the newly minted version of the PalmPilot—3Com's wildly popular electronic organizer—has an option that transfers electronic business cards to other Palm IIIs. (3Com has dropped the PalmPilot moniker, because of a trade-

mark conflict.) By aiming the infrared window at another Palm III and pressing the Address Book button, you can wirelessly transfer your business card, which will show up on the recipient's display. Last year, shipments of hand-held organizers topped 1.6 million, representing the world's fastest-growing computer segment. 3Com pocketed a 66 percent share for the first half of 1997.



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Java Spectacular

This issue's feature stories on Java continue online, where you can test the performance of your own Java virtual machine.

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Pipeline

Could You Fill a 165GB Disk?

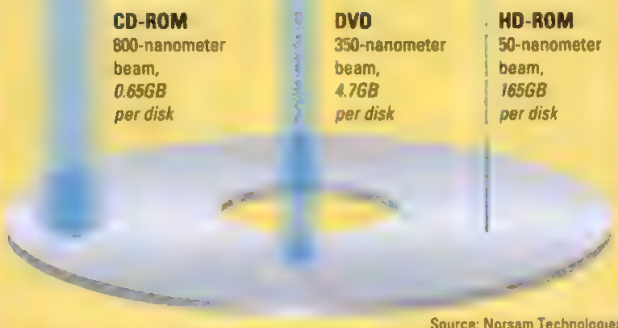
DVD—the super-high-capacity disk designed to replace CD-ROM—eventually—has barely taken off, and already another super-duper-high-capacity technology has appeared on the scene. Norsam Technologies, created through a technology-transfer program at Los Alamos National Laboratory, is developing a system for writing data to disks that's fundamentally different from other optical technologies.

The Norsam HD-ROM (high density—read-only memory) disk

The Skinny on Beams

Norsam Technologies uses a charged gallium ion beam in its HD-ROM technology to pack more data in a smaller space than existing laser technology—used in CD-ROM and DVD—permits.

CD-ROM	DVD	HD-ROM
800-nanometer beam,	350-nanometer beam,	50-nanometer beam,
0.65GB per disk	4.7GB per disk	165GB per disk



Source: Norsam Technologies

uses a highly focused beam of charged particles instead of the much larger laser beam. According to Norsam, a charged-particle beam can focus on a 50-nanometer spot, producing so-called pits that can pack as much as 165 gigabytes of data on a disk.

But that's just writing data to the disk. What about reading the data off of the disk? Norsam plans to collaborate with IBM's T. J. Watson Research Center, where scientists have developed a disk-reading technique called Scanning Interferometric Apertureless Microscopy.

Superparamagnetic Limits

Want a hard disk that holds 20 times as much data as today's most muscular disk? Seagate Technology's Quinta division claims to have found a way to get there with lasers, mirrors, and fiber-optic lines.

Recent years have seen huge leaps in how much data hard disks can store. There's a limit, however: the superparamagnetic limit. Believed to be between 20 and 40 gigabits per square inch, the superparamagnetic limit is the point at which traditional hard disk media can no longer store data reliably.

The new Optically Assisted Winchester (OAW) technology uses lasers to generate light pulses, which are reflected by mirrors and carried over hair-thin fiber-optic lines through a disk's read/write head. There, the light highlights data on the disk's surface. The result will be disks that can hold 10 to 20 times as much data as current ones, because of greater data density.

The first product to incorporate the new technology will show up in about a year.



ILLUSTRATION BY ROBERT NEUBECKER

THIS ISSUE'S CONTRIBUTORS: Carol Levin, Melissa Perenson, Sebastian Rupley, and Don Willmott.

Web on the Run

Do you miss the Web when you're driving to work?

Through a new partnership between Audible and RealNetworks, commuters can listen to news broadcasts from the Web while on the run.

At the new Mobile Daily Briefing Web site run by the two companies (www.dailybriefing.com/mobile), a number of content partners are offering daily broadcasts of Web-based news for download to the Audible MobilePlayer, a hand-held PC peripheral that holds up to 2 hours of spoken audio content and works with headphones or car stereo systems.



WEB INSIDE:
Audible
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You can select programs from several broadcast and entertainment companies, including America Online's Entertainment Asylum, CBS SportsLine Sports Minute, C/NET, NetRadio Network, PC Week Radio, PlanetOut, Pseudo Online, and SonicNet/Addicted to Noise.

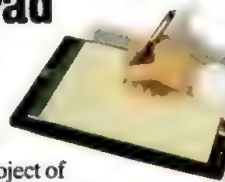
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Source: Computer Intelligence Infobeads Data for December 1997.

The \$399.95 Legal Pad

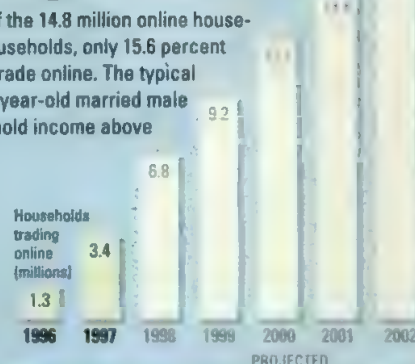
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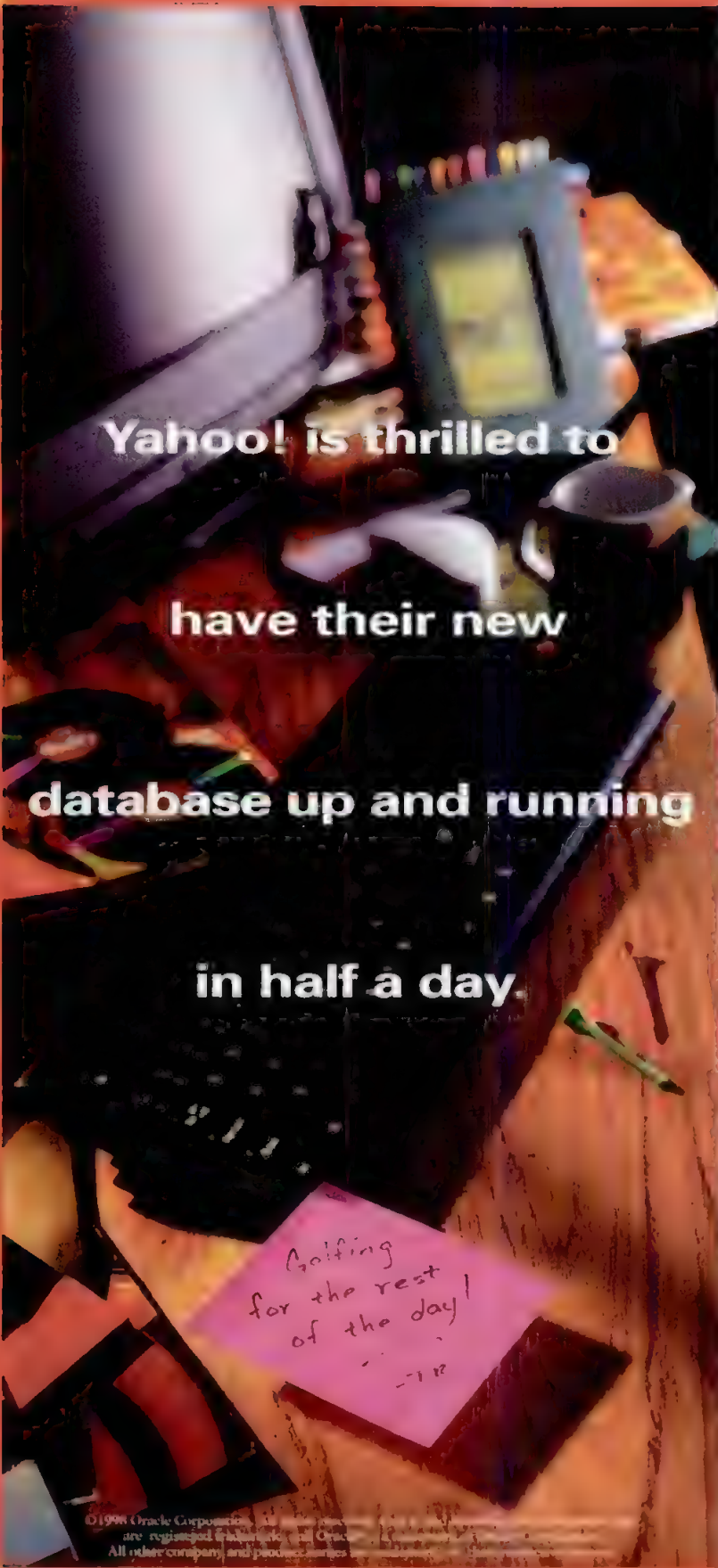


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Source: Jupiter Communications, 1998





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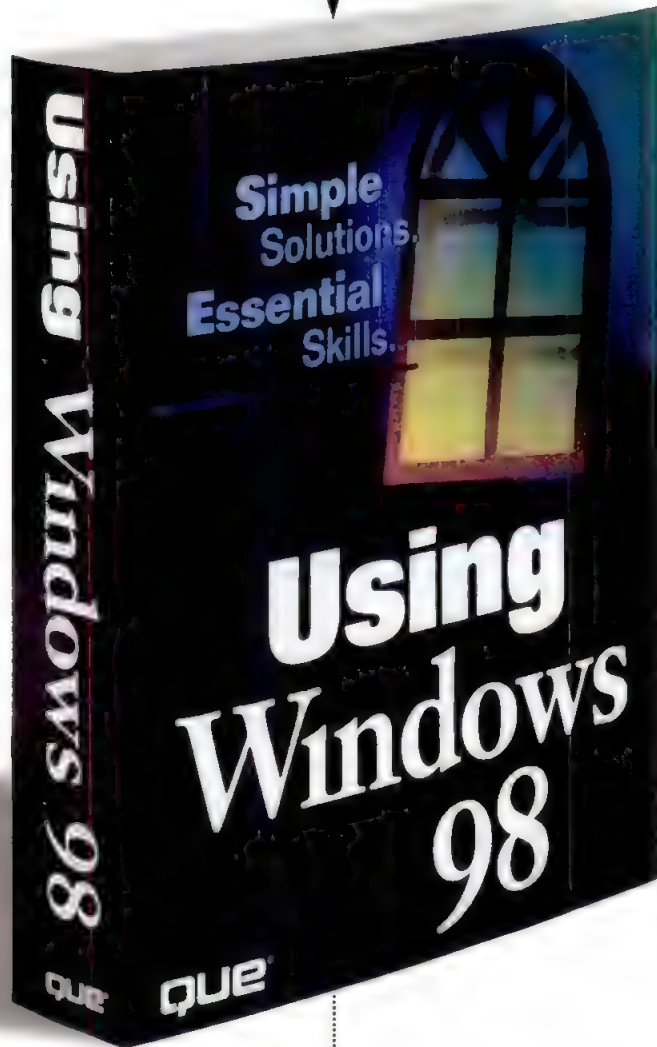
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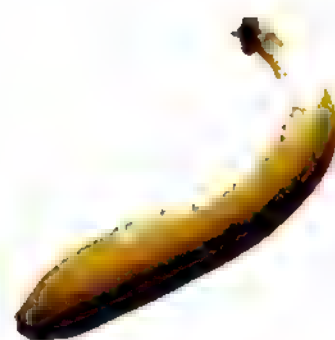
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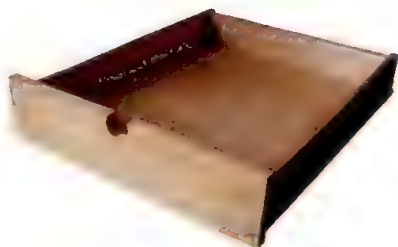
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EXPECT THE EXTRAS

Letters

GRASPING THE ENORMITY OF Y2K

Jim Seymour, in his February 10 column ("The Hidden Side(s) of Y2K"), highlights a problem whose enormity most people cannot even begin to grasp. If you don't think the Y2K problem is real, try going into a Blockbuster Video store and renting a movie with a credit card that has a year-2000 expiration date. Or try to transfer a Visa balance from a Chase Visa card to another card with an expiration date that falls in 2000. First, these are not small companies; second, the companies are not unaware of the Y2K problem. I fear it is a bigger problem than we have the manpower to address.

GLEN FOUNTAIN
via the Internet

Seymour's article on year-2000 compliance accurately reflects the current sad state of affairs around the world as the millennium approaches. Although the fallout from a world gone mad—come January 1, 2000—could be spectacular, there's another issue nobody is talking about: Y2K compliance on PCs in the home. Perhaps an article in the near future on how to ensure that your home or stand-alone small-business PC is Y2K-compliant would save a lot of future aggravation. Big business melting down is one thing, but it's too abstract a concept for many people to grasp. Trying to log on to the Internet on New Year's Day, 2000, with a computer that doesn't know what year it is will strike a chord with everybody—as soon as they realize they can't access their e-mail.

DAVID HORNISH
via the Internet

The few businesspeople I have talked to who have actually tackled their Y2K problems are unanimous in saying that they gave up trying to trace Y2K in their legacy programs and just rewrote the programs they needed to run the business. The biggest problem was addressing legacy databases in relation to new ones. My guess is that, as the crunch nears, a lot of people will decide they do not need proprietary software.

ROBERT E. BURT
via the Internet

Seymour is right when he asserts that companies are moving very slowly to solve the Y2K problem. We have experienced this. My wife was nearly denied admission to a local hospital that belongs to one of the largest hospital groups in the country because it wanted her copayment up front. The credit card she presented expires in November of 2000. The hospital's computer incorrectly reported that the card had expired. Imagine being denied essen-



*Companies are moving
very slowly to solve the
Y2K problem.*

tial services, even emergency services, because the company you are trying to conduct business with hasn't fixed its Y2K problem.

DICK BATISTE
via the Internet

NOT OPEN TO WINDOWS 98

In response to Michael J. Miller's "Whither Windows 98?" (February 10): I have no problem with Microsoft including features developed by third-party software developers in an updated Windows OS, provided Microsoft pays original authors/developers for the right to their ideas and concepts. I do have a problem with Microsoft "engineering" workarounds that permit Microsoft to adopt concepts and ideas developed commercially by third parties but to avoid any payments and royalties to the owners. Unfortunately, I am pretty much convinced that Microsoft's routine predatory business practices favor the latter approach, and Microsoft certainly has adequate resources to make it possible. I also have a problem with a "new" OS if its primary objective is merely to make existing software obsolete and enhance sales of "new" proprietary software.

ED UNGER
Houston, Texas

Miller should try using Windows 3.1. It lets you simply put all the settings for each application into their own INI file. Thus it is extremely easy to uninstall applications and correct application-setting files that become corrupt. In addition, you can easily move files such as GRP files to a floppy disk to back up your icon settings. No longer can a single application destroy a file such as the registry, requiring you to

reinstall all applications. The feature gives the user complete control of the PC. And best of all, you don't need to purchase any of the third-party utilities out there to fix, repair, or diagnose your system problems.

AL FRANZ
via the Internet

THE LIFE OF A BATTERY

I am most impressed with the breadth of testing and comparison of this year's Tillamook notebook array ("High-End Notebooks," January 20). But I am curious about two things. First is the inclusion of a subnotebook from IBM, which overbalances the battery life scores. Other than the battery life and weight, this machine seems unexceptional. The battery life score certainly trounces the competition (expected in subnotebooks), but it is unfair to compare it with high-end notebooks.

Second and more important, your benchmark tests for performance emphasize that the machine should be configured for performance. But the test results do not reflect the amount of effort and the steps required to change these configurations to favor long battery life, what the battery life configurations are, and so forth. Additionally, you did not note the reduction in benchmark test scores in the battery savings configuration. I think this is a critical issue. If you sacrifice performance for battery life, then the longer battery life is not worth having.

JAMES BUNNELL
via the Internet

We included the IBM ThinkPad 560X because it is our common editorial practice not to exclude any nationally distributed product that satisfies the review criteria established before the roundup. Although we agree that it would be interesting to test the notebooks with power management enabled, we chose our testing parameters based on our principles and other practical considerations. Our benchmark tests, by design, are very sensitive to the timing of system activities. Thus, many components of power management introduce additional sources of measurement variance that severely affect the reproducibility of benchmark test data. Also, power management is implemented in various ways, so each notebook may react differently to certain activities in the benchmark test script, destroying the correlation between the results and real-world performance.—Ed.

FACE-TO-FACE TALK IS NOT CHEAP

Bill Machrone really must have awakened on the wrong side of the bed prior to writing his column "Perfect Talk, Perfect Silence" (February 10). I find that the more methods of communication we have, the better we can get our message out. For a quick yes or no, e-mail can



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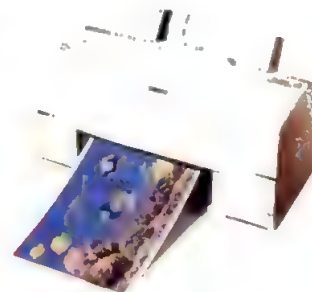
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Letters

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JOHN TRINKAUS
via the Internet

Yes, it does look as if the human-to-human interface is declining. Although this is a sociological issue related to information technology (IT), I think it's only one symptom of our disintegrating society. We have heard concerns about computers, about the non-human-contact issue, about Internet access (objectionable materials, secure transactions, scams, spams), and many other issues. My contention is that they are not computer issues but social issues. We have focused on self and away from moral and social values—leading to the diminution of community, including the decline of interpersonal skills and a growing discomfort with others. This is important in IT, and especially the IT press, because we need to understand that these issues are not really ours to solve. No chip is going to make us moral. No e-mail key escrow is going to make us law-abiding. No type of encryption is going to make us secure.

ERIC L. VAN DUSEN
Pasadena, California

OPTICAL DISAGREEMENT

Regarding your article on OCR software ("Word for Word," January 20): I owned Caere Corp.'s OmniPage Pro, but after reading the reviews, I decided to purchase Xerox's TextBridge Pro. After trying both products, I think your article was a bit off. TextBridge Pro is slightly more accurate, but that is all. With OmniPage Pro, I can get a final copy that al-

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CORRECTIONS AND AMPLIFICATIONS
In the February 24 story "Graphics Workstations," in the review of the Intergraph TDZ 2000 3D, we incorrectly stated that this unit had the highest price in the roundup. Its price is \$15,000 street; the HP Kayak XW PC Workstation was the highest-priced unit, at \$20,570 street. In the same story, the deck (above the title) states that we tested six Windows NT workstations; we actually tested seven.

In the February 24 After Hours review "Taming the 1040," we stated that both TaxCut Deluxe and TurboTax Deluxe have multistate editions. Only TaxCut offers a multistate edition.

In the February 10 Inside Track column, we referred incorrectly to Intel's IA-64 processor as a 64-megabit chip; it is a 64-bit chip.

The sidebar titled "Web Editing for Nearly Nothing" on page 160 of our issue of January 20 contains an incorrect URL for JMK HTML Author 4.01. The product can now be found at jmk.simplenet.com/prod/jmkhtml.htm.

In the January 20 Net Tools article "Fast Connections in Small Packages," we incorrectly stated that Windows NT RAS lacks a callback function.

most matches the original in font, style, and layout. With TextBridge Pro, my output rarely even comes close to matching the originals. Font sizes are way off, and columns are not formatted correctly. It requires a lot of work to get the page formatted correctly, much more than correcting a couple of errors does. Also, many of the extra mistakes caught by OmniPage Pro are spelling errors, which TextBridge Pro never catches. Luckily for me, Xerox will take back my copy of TextBridge Pro. OmniPage Pro should have won your Editors' Choice.

ERIC GALE
via the Internet

NEED A HAPPY MEDIUM

Your roundup of digital cameras ("Crossing the Threshold," February 10) was interesting, but it fell short by not going upscale quite far enough. Interestingly, your article "Digital Cameras: The Death of Film?" (February 6, 1996), published when digital cameras were less common, covered a more representative range. It seems that none of the photography magazines know computers well enough to provide meaningful coverage of digital cameras, and none of the computer magazines know enough about real photography to do it either. I have never seen a computer magazine that addressed the ability of these cameras to be used for anything other than snapshot photography. Photography magazines seem to dismiss them as toys, except for the very high-end equipment. There is a lot of user interest in cameras that provide slightly better image quality and a lot more control and utility but are not as expensive as cameras such as the Kodak DCS 410/420/465 series.

JAY GARNIER
via the Internet

HANG ON, FLOPPY, FLOPPY HANG ON

Although John C. Dvorak makes several good points about removable-media drives ("The Fight to Be the New Floppy Disk,"

February 10)—specifically the Iomega Zip Drive—one point he overlooks is reliability. Both the Zip Drive and the Jaz Drive have terrible reliability records, a fact overlooked in most of the glowing reports and reviews of the drives. Also, they are difficult to configure; they do not have plug-and-play capabilities; and many systems have trouble recognizing them. The drives are really just interim "solutions" that offer far greater storage than any floppy disk but lack the reliability of either disks or drives, and they are generally poor backup media as well. They are best used for archiving easily replaceable files.

MICHAEL SOLOMON
via the Internet

Dvorak's generalizations illustrate a paucity of knowledge and experience with removable-storage drives. One or two of them (but certainly not the Zip Drive) might function as bootable drives under Windows 95 but not under Microsoft Windows NT. If you can't boot to your primary floppy disk drive, what good is it? When you attempt to load Windows NT, whose installation starts with three 1.44MB disks, the setup routine doesn't recognize these nonstandard drives and fails. Dvorak also neglects to mention that the LS-120 does not accept the format command under Windows NT. Until a new standard is established, we're going to need that 1.44MB drive.

BRAD BENNETT
via the Internet

Do we really need a new floppy disk drive? Dvorak says it will take five to six years. Within that time, DVD-RAM should have caught on, and it might even decrease in size. This would be the perfect floppy disk drive replacement: one less drive on your computer, and no need to wait for a separate technology when you need a larger drive.

DAVID MATSON
Midland, Michigan

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Trends

Fingertip PCs

Researchers envision an entire PC on a chip.

The term *microcomputer* may take on a whole new meaning early in the next century, when it may be possible to create an entire computer—including the display—on a single silicon chip.

In recent years, advances have been made in micropanel display technology, which is used to create tiny displays on silicon wafers. These are then used for applications ranging from head-mounted displays and electronic camera viewfinders to portable projectors. Liquid crystal displays (LCDs) are the best known, but other micropanel technologies include micro-mechanical Digital Light Processing (DLP) chips from Texas Instruments, as well as a variety of emissive and reflective designs.

At the same time, there has been a move toward higher levels of integration on individual chips. The increasing numbers of transistors and amounts of on-board memory for central processing units (CPUs) such as Intel's Pentium microprocessors are examples of this trend, as is the new Cyrix MediaGX Processor, which incorporates CPU, sound, and graphics controller functions on a single chip.

Many developers of micropanel displays are seeking ways to integrate functions in addition to the display on a single chip, but there are some serious obstacles. The production processes required to create various components on a single chip may be quite different, and even if these processes are compatible, the effects on factory yields may make it more practical to produce separate chips. Also, the components may have different operating voltage and current requirements, making it difficult to supply the appropriate type of power to the different parts of the chip.

Researchers at the Electro-technical Laboratory in Japan may have found a way to solve some of these problems. Junji Itoh and Seigo Kanemaru presented their results last fall at the International Display Research Conference in Toronto, Canada. Their research focused on the production of field emission displays (FEDs) on silicon chips. Other approaches to making FEDs have required high voltages and

complex construction techniques. Their paper described using metal-oxide-semiconductor field-effect-transistor (MOSFET) techniques, an approach that simplified the production process and yielded some fascinating benefits.

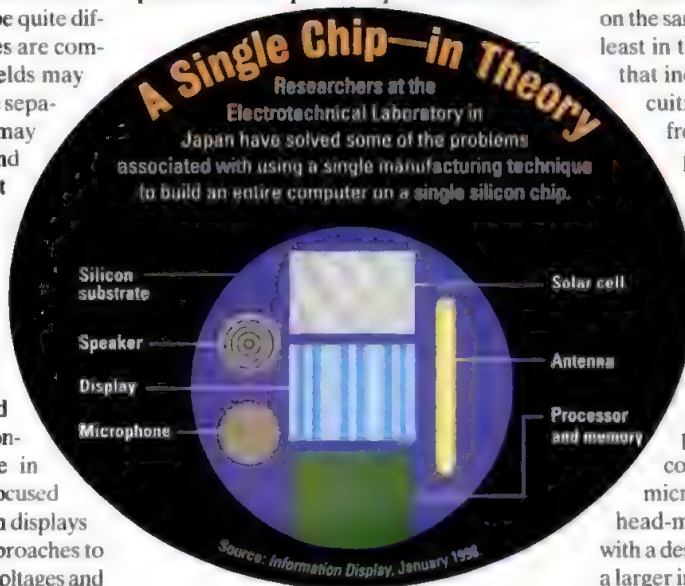
A FED relies on thousands of tiny electron emitters to light up phosphors similar to those on a standard CRT. The new process makes it possible to associate so-called "dual-gate" or "trigate" structures with each emitter. These "logic gates" are essentially on/off switches, the fundamental building blocks of a logic device. The presence of the gates makes it possible to turn the display emitters on and off without relying on additional devices on the chip. An important side benefit of this process is that it greatly reduces the voltage required to drive the individual emitters. This not only lowers the power consumption of the display but also makes it more compatible with the power requirements of other

semiconductor components, such as processor and memory circuitry.

INTELLIGENT FEDS

Itoh and Kanemaru have named this approach *intelligent FED*, or *i-FED*, and they envision the integration of other components on the same silicon substrate as the display. At least in theory, it's possible to design a chip that includes processing and memory circuitry, a speaker, a microphone, radio-frequency broadcast and reception capabilities, and solar power cells.

The result could be inexpensive and compact devices for a wide range of functions. For example, this approach could be used to create an intelligent wireless phone that could be used with voice recognition to send and receive e-mail and browse the Web. Or you could have a complete computer system that used a wireless connection to a remote keyboard. The micropanel display could be used for a head-mounted display or in conjunction with a desktop projection monitor to generate a larger image.—*Alfred Poor*



E-Commerce: The Missing Link

The action is in application servers.

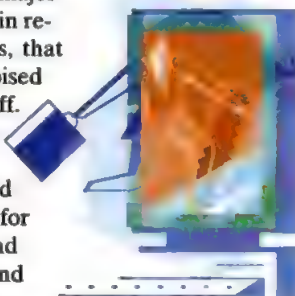
Web browsers may get all the attention, but the competition is just as fierce in the Web server market. And guess who the main contenders are: Microsoft and Netscape. Application server software, which lets businesses develop applications for flexible yet secure online transactions, can be described as the missing element in the efforts to bring electronic commerce into the mainstream and extend corporate intranets out to customers and business-to-business applications.

With two major deals made in recent months, that market is poised for a lift-off. Businesses' increasing need to build applications for intranets and extranets and to integrate these applications with legacy mainframe, Unix, and Windows NT applications is driving the computer industry's heaviest hitters into the market.

Microsoft recently announced a partnership with NetDynamics, a leading developer of application server middleware. The companies plan to integrate NetDynamics' software with Windows NT through the Component Object Model (COM), which provides the framework for letting disparate enterprise apps work together. The result will let NetDynamics bridge the Unix and Windows NT environments.

The deal comes on the heels of Netscape's acquisition of Kiva Software, whose application server acts as a middleman between standard server software (such as Netscape's SuiteSpot) and Java clients. A customer who wants to access a back-end database at a large enterprise, for instance, would do so from a Java client through Kiva's application server.

According to Netscape CEO Jim Barksdale, "Kiva provides an important strategic technology for linking people and businesses together through extranets." He adds that Netscape plans to become "the leading provider of enterprise-class application server software for extending corporate intranets out to customers, suppliers, distributors, and partners."—Angela Hickman



Does Your Notebook Run Hot?

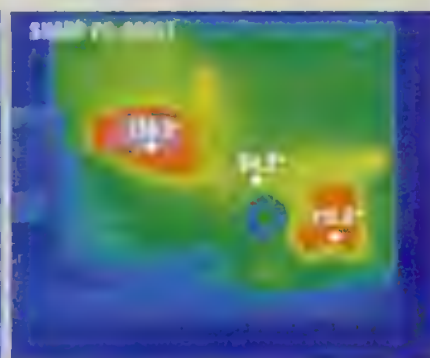
AS PART OF OUR LATEST EVALUATION of high-end notebooks ("High-End Notebooks," January 20, 1998), PC Labs took infrared photographs of each model to produce heat images and find out how well the notebooks distributed heat. A hot notebook can cause performance and reliability problems—not to mention a hot lap for its user. If it gets too hot, it'll slow down. If it gets really hot, it'll shut down.

How hot is too hot? That's hard to say—which is why we didn't recommend specific notebooks based on the thermal photographs—but if a notebook has a surface temperature of 140 degrees Fahrenheit or above in any spot you can touch, you'll definitely notice it. Intel specifies that its

throughout the unit and move it to the outside as efficiently as possible. For most notebooks, the bottom surface heats up the most; the top side has the keyboard, through which heat can more readily dissipate. Thus, the bottom side best shows the heat distribution inside the notebook.

After placing each notebook in its normal orientation on a table and running our ZD CPUmark₃₂ benchmark test for 30 minutes, we quickly shifted the notebook to the test table and very briefly tilted the notebook to photograph the bottom—the hottest surface with which you'd come into contact.

None of the notebooks that we tested



INFRARED EXPOSE: Heat-dissipation techniques vary widely. The red areas are hotter, blue areas are much cooler, the hottest areas are a grayish purple, and the medium-hot areas are yellow and green. Each notebook uses a 233-MHz Tillamook processor, which shows up as the hottest spot.

Tillamook processors can operate reliably with a direct measured surface temperature of up to 95 degrees Celsius (203 degrees Fahrenheit), which is painfully hot. Our external readings are significantly lower than what you'd find on the CPU chip's surface.

In "Infrared Exposé," which you can find on PC Magazine Online at www.zdnet.com/pcmag/features/notebook3/heat.htm, we noted that most notebooks we examined—including ones from Akia, ChemBook, Hewlett-Packard, and Sony—had case-surface temperatures of well under 120 degrees. Everex, Micron, and Sharp notebooks had areas hotter than 120 degrees.

The best thermal designs spread heat

produced surface temperatures above 160 degrees, which would have entered the realm of "safety hazard" as defined by UL Standard 1950 for technology equipment using molded plastic or rubber housings that touch human skin for sustained periods. But from a comfort perspective, a more relevant UL standard is that for medical devices: UL Standard 2601 specifies that any medical device in contact with the skin for sustained periods shall not exceed 106 degrees Fahrenheit (41 degrees Celsius), in order to maintain user comfort. Notebook surface temperatures from 120 degrees to 140 degrees Fahrenheit can get quite uncomfortable with sustained contact.

—Nick Stam

Multimedia Maestro

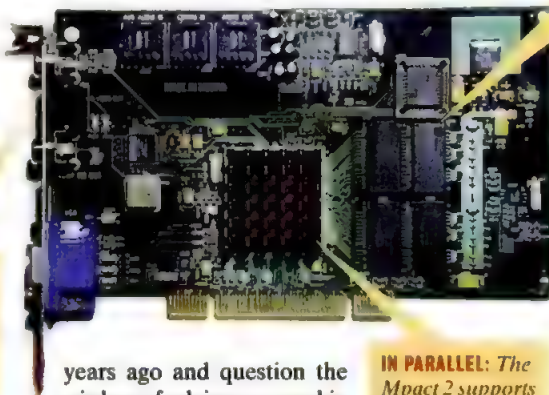
Chromatic delivers all-in-one chip.

Try to configure a fully equipped multimedia PC and you may find yourself running out of system resources. Even if you have enough IRQs for your sound card, internal modem, graphics adapter, and DVD decoding card, you may not have enough slots to hold these devices—not to mention the budget to buy them all.

Chromatic Research may have the answer with its new Mpack 2, a multimedia accelerator chip available in upgrade cards this spring. This one programmable chip can do it all: sound, modem, 2-D and 3-D graphics, and even DVD decoding. Chromatic Research engineers have put all of these functions on a single PCI card that requires only a single IRQ.

You may remember the trials of the digital signal processing (DSP) products from a few

SINGLE SLOT:
An Mpack 2 card can connect everything multimedia.



years ago and question the wisdom of relying on one chip for all these functions. DSP chips were also programmable, but they tended to be slow and could perform only one function at a time. It took time for a card to change from running as a modem to running as a sound card.

The Mpack 2 is different. Based on parallel-processing techniques, it can process up to 6,000 MOPS (million operations per second). And since the chip is programmable, card designers can add functions through software. Chromatic Research has already built demonstration boards that combine 2-D and 3-D

IN PARALLEL: The Mpack 2 supports Dolby AC-3 and 3-D graphics.

HIGH POWER:
Aside from the Rambus memory, the card has few parts.

graphics acceleration with DVD decoding functions, including MPEG-2 decoding and Dolby AC-3 surround sound, and it's exploring ways to add support for cable modem and digital subscriber line connections for high-speed Web access.

The company has also made strategic alliances for key technologies. Motorola, for example, is providing software that adds its 56K modem technology to the Mpack 2's repertoire. The Mpack 2 will also support V.90, the new international standard for 56-Kbps modems.

Reduced manufacturing costs are the key advantage of a multifunction chip. Chromatic Research is targeting sub-\$1,000 computers as candidates for the Mpack 2. Compaq Computer, Gateway 2000, and Micron are just a few of its customers.

Look for the first upgrade cards this spring. Diamond Multimedia has already announced a DVD upgrade kit based on the Mpack 2, and other announcements can be expected soon.—*Alfred Poor*

JAKE KIRCHNER

Let's Hope Microsoft Acquires Coors!

Bizarre is not too strong a word to describe the latest battle in the browser wars. Netscape's recent decision to give away its Navigator and Communicator products has cleared the field for the company to go head to head with Microsoft to determine which company can give away more free software.

Netscape had to do something to counter the growing market share of Microsoft Internet Explorer, which has always been free. It's amazing that Netscape was able to maintain its lead for so long against Microsoft, which shows that users care enough about quality software that they'll pay for a product even if the next-best choice costs nothing. Only when Internet Explorer pulled even in quality did it make any real inroads into Netscape's market share.

Announcing the decision to match Microsoft no-dollar for no-dollar, Netscape also called itself an "enterprise software solutions" vendor. Providing free browsers will help expand the market for its systems software products, the company explained. Imagine if beer companies did business this way! You'd go to the market to buy your groceries and you'd be offered free six-packs of Coors or Budweiser at the checkout counter. Which would you take? Dumb question, I know. You'd take both, of course.

That may be exactly what happens in this instance: Everyone will end up with both browsers, as we've recommended for years. As long as both products are free and remain equal in capabilities, you'll have little incentive to pick only one of them.

I do worry that Microsoft and Netscape will slacken in their efforts



to improve their browsers. Why improve them without any profit incentive? Sure, both companies will want people to use their products, because that helps build related markets, but the lack of profit can slow down R & D funding. Has there been any earthshaking improvement in office suites since Microsoft Office took over?

Speaking of Office, you'll remember that when Microsoft began including Microsoft PowerPoint in its office suite, the company captured the market for presentation software. Here too, the Microsoft product was basically a freebie. Even when PowerPoint wasn't the best package, buyers were happy to accept it. Products that at the time were better—notably Harvard Graphics—saw their market shares disappear. Too bad Harvard Graphics' publisher, Software Publishing Corp., couldn't afford to give away the software.

All of which leads me to wonder how Netscape can afford to give away its software—and whether it should be allowed to. Since the Justice Department believes it was illegal for Microsoft to use dominance in one area (operating systems) to try to muscle into an area it doesn't control (Internet software and services), is it okay for Netscape to use the power of its browser market share to help it muscle into an area it doesn't control (enterprise software)? Maybe Microsoft wouldn't have gotten into hot water if it had given away Windows and charged for Internet Explorer.

But this competition is bizarre enough as it is. I'd hate to have to start paying for browsers again. Better we just count our blessings and surf happily ever after.

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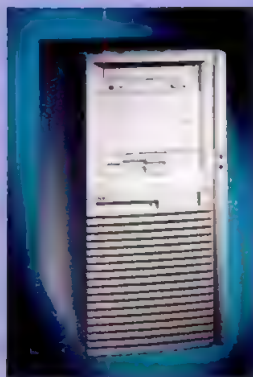
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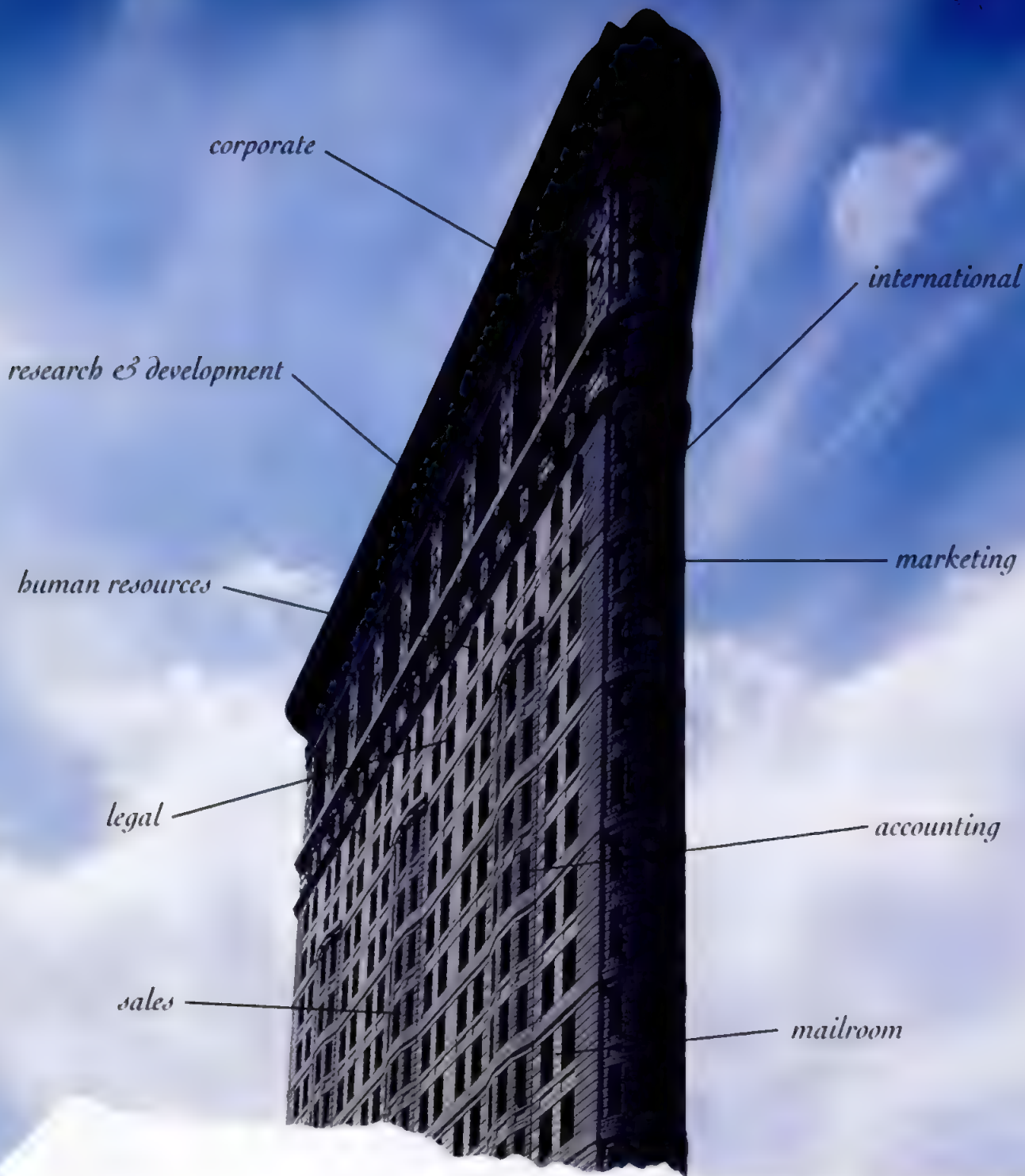
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NOTEBOOKS

Tillamook: Still Going Strong

Though most in the industry are patiently awaiting Intel's mobile Pentium II, the Pentium laptop is far from taking its last breath. For the better part of this year, Tillamook notebooks—those machines whose 166-, 233-, and 266-MHz MMX Pentium processors are manufactured on Intel's 0.25µ process—should offer much longer battery lives than their Deschutes siblings. The 166- and 266-MHz Tillamook chips have given rise to a whole new wave of mainstream notebooks.

Compaq Computer Corp. (800-345-1518, www.compaq.com) has added two 266-MHz systems to its Armada line of notebooks. As opposed to the Armada 7792DMT, a “no compromises” desktop replacement, the \$4,999 **Armada 7380DMT** is a

desktop replacement for those desiring a slimmer, lighter form. Only 1.5 inches thick and weighing 6 pounds, this off-white portable includes a 266-MHz Tillamook, 512K of secondary cache, 32MB of EDO RAM (expandable to 128MB), a 4GB Smart hard disk, a 20X max CD-ROM drive, and a 33.6-Kbps modem that's upgradeable to 56.6 Kbps. The active-matrix 12.1-inch display is backed by 2MB of video DRAM.

According to Compaq, the 7380DMT's lithium ion battery affords up to 3 hours of battery life—a figure that's in agreement with most Tillamook machines. In addition to outfitting the system with 16-bit Sound Blaster Pro-compatible audio,

Compaq ships models with Microsoft Windows 95 and NT.

Compaq's third Tillamook offering is the versatile **Armada 4220T**. This \$3,999 machine can be stripped down to a 5-pound configuration, but it also upgrades to a less-modest multimedia box.

The base system includes a 266-MHz Tillamook, 32MB of RAM,

VISION IN VALUE: The *VisionBook Plus 5000* notebook, new from Hitachi.



512K of secondary cache, a 64-bit graphics subsystem with 2MB of EDO video memory, a 12.1-inch SVGA

RECAP PC Magazine reviewed Tillamook notebooks in our issue of January 20, 1998. An Editor's Choice was awarded to the IBM ThinkPad 770, the IBM ThinkPad 560X, and the Gateway Solo 2300.

display, and a lithium ion battery. To this base system you can attach two additional lithium ion batteries (for up to 10 hours of battery life, according to Compaq), an external floppy disk drive, and an optional 20X CD-ROM module that attaches to the machine's underside.

This ACPI-compliant (Advanced Configuration and Power Interface) portable is typically shipped with Windows 95, but it is optionally available with Windows NT and Windows 3.x. Compaq also provides 32-bit CardBus support and bundles each system with a suite of audio applications. Like the 7792DMT and 7380DMT, the Armada 4220T is accompanied by a three-year warranty.

This spring, Hitachi PC Corp. (800-555-6820, www.hitachipc.com) has entered the SOHO mobile market with the **VisionBook Plus 5000** series. With prices starting at \$1,700, these value-oriented systems use 166- or 233-MHz Tillamook processors, 2.1GB or 3.2GB hard disks, and 16MB or 32MB EDO RAM configurations. Each VisionBook includes 256K of secondary cache, a NeoMagic 2160, a graphics chip set with 2MB of VRAM, a 12.1-inch SVGA dual-scan display, and 16-bit Yamaha FM synthesis sound.

Hitachi's single modular bay can accommodate a standard floppy disk drive, a 20X CD-ROM drive, an optional LS-120 drive, or an optional Zip drive. The company also provides an internal 56.6-Kbps modem, CardBus support, and Zoomed Video. Though the machine ships standard with a nickel hydride battery (providing 4 hours of life, according to Hitachi), it can accept a lithium ion battery (4.5 hours) as well. Hitachi's warranty on this 6.2-pound notebook extends for just one year.—Cade Metz

Acer Adds Inexpensive Home PCs

Acer America Corp. has recently announced a spring update to its line of **Aspire** desktop PCs (800-733-2237, www.acer.com). Aimed at first- and second-time home buyers alike, the update includes a 233-MHz AMD K6 machine priced at \$799 (sans monitor) as well as Pentium II configurations priced from \$1,499 (also without monitors).

The Aspire 1822, selling for \$799, includes 16MB of EDO RAM, a 2GB hard disk, a 24X CD-ROM drive, and a 33.6-Kbps modem. A 200-MHz version, the **Aspire 1810M**, sells for \$999 with 32MB of EDO RAM and a 14-inch monitor, while the **Aspire 1830**—a 233-MHz K6 with 32MB of SDRAM, a 4.3GB hard disk, a 24X CD-ROM, and a 56.6-Kbps modem—is priced at \$1,099. Each 1800 series system is outfitted with 256K of secondary cache, one open PCI slot, and an empty 3.5-inch front-accessible drive bay; the 1830 also has an open ISA slot.

The latest Aspire line also includes two Pentium II configurations. Priced at \$1,499, the **Aspire 2850** con-

tains a 266-MHz processor, 32MB of SDRAM, a 4.3GB hard disk, a 32X CD-ROM, and a 56.6-Kbps modem. Its \$1,799 sibling, the **Aspire 2860**, offers a 300-MHz Pentium II, 48MB of SDRAM, and a 6.4GB hard disk. Both configurations are augmented with ATI 3D Rage Pro AGP graphics (equipped with 2MB of memory on the 2850, 4MB on the 2860), software-based MPEG playback, and two front-accessible 5.25-inch bays.

All new Aspires ship with Acer's regular suite of “customer empowerment” software (the Acer Information Center, Acer Service Center, and Acer Computer Explorer), free Internet access (through the GTE Internetworking Services), and several well-known

software titles (including Microsoft Encarta, Microsoft Works, Microsoft Money, and Intuit Quicken Basic 98). The 2850 and the 2860 also each bundle a 3D/AGP gaming package known as Incoming, while the 1830 ships with the MMX title POD. Backed by Acer's one-year warranty, Aspire desktops are sold by a wide network of major PC retailers.—CM



Trends Software

GRAPHICS

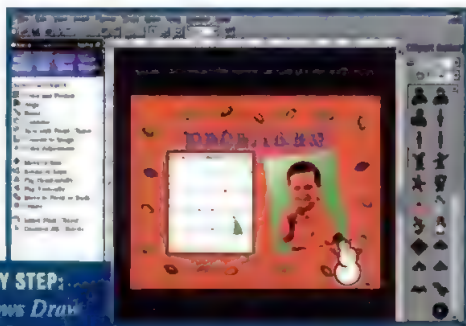
Your Own Creations

With each new development in the graphics software business, the level of sophistication and subtlety available to designers continues to grow. As companies rush to develop Web-friendly and animation-intensive applications, the ruthless competition should ensure that the standard of applications remains high.

Canon Computer Systems (800-848-4123, www.ccsi.canon.com) takes its popular printer-creativity software to market and enters the software-publishing business with the retail release of **Canon Creative** (\$50 street price), **Web-Record** (\$30 street price), and a new imaging program titled **PhotoOp** (\$50 street price).

Canon Creative offers a col-

lection of personal and business applications for making greeting cards, T-shirt transfers, bro-



STEP BY STEP:
Windows Draw
6, new from
Micrografx.

chures, newsletters, and more. WebRecord includes a complete package for accessing, browsing, fetching, formatting, and printing images off the Internet. PhotoOp operates as your digital photo album; with

the program, you can share multiple images and organize them for later access.

Windows Draw 6 (\$50 street), from Micrografx (800-417-8314, www.micrografx.com), is the latest version of this veteran general-purpose drawing, diagramming,

and publishing program. Beginner and advanced modes make it simple to learn how to use the product's deep feature set at your own pace.

Included with the package are hundreds of professional designs and interactive step-by-step instructions that simplify the

process of creating your project; project wizards and predefined page layouts further aid in the design of multipage documents. The Style Gallery catalogs hundreds of styles and effects that you can use to jazz up your page.

You can output HTML pages for publication on the Web without using any HTML; in fact, Draw comes packed with an assortment of Web-ready artwork, a Web Publishing Wizard, GIF and JPEG image savers, and the Animated Gif Wizard.

Meanwhile, the BioGraphics Research Group of the Hutchinson Avenue Software Corp. (514-499-2067, bgr.hasc.com) is offering two 3-D modeling packages that can be used either as extensions for **Ray Dream Studio 5**, MetaCreations' 3-D modeling and animation package, or as standalone solutions for any animation system that reads DXF files. **Tree Druid** (\$100 street) is a procedural modeler extension for the generation and animation of trees. **Thor** (\$50 street) is a procedural modeler extension as well, this time for the generation and animation of electrical effects such as lightning.—Sharon Nash

IMAGE EDITORS

Pictures Perfect

Snapping photos is only half the fun—the other half is having the chance to manipulate them digitally on your PC. Although neophytes who need hand-holding will appreciate such packages as Adobe's PhotoDeluxe and Microsoft's Picture It!, those looking for more autonomy can turn to software from Ulead Systems (800-858-5323, www.ulead.com) and JASC Software (800-622-2793, www.jasc.com).

PhotoImpact 4 (\$100 street price), the latest upgrade to Ulead's image-editing package, provides greater integration with Microsoft Office and a host of Web design features. It includes new and improved versions of Ulead's GIF Animator (which offers a variety of frame transition effects), QuickTime import support, and simulated browser previews for Netscape and Microsoft. It also comes with the Button Designer, which

now features precrafted anti-aliased buttons for Web pages, and the Background Designer, whose natural-texture engine makes it easy to customize your own backgrounds. As with earlier versions, there is support for Adobe



PhotoShop plug-ins.

The product also features a macro recorder for conquering repetitive tasks, improved color

management for HTML authoring, the ability to create Web-based slide shows, and the improved SmartSaver 3.0, which intelligently optimizes GIF, JPEG,

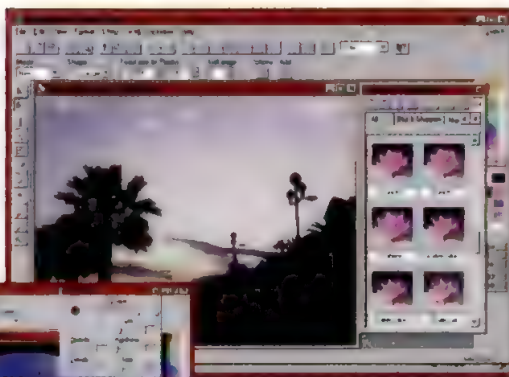


PHOTO MAGIC:
Image editors from
PhotoImpact 4
(above) and
PaintShop Pro
5.0 (left).

transparent JPEG, and PNG image files for publishing on the Web.

A longtime staple on the shareware front, JASC Software's \$99 **Paint Shop Pro 5.0** goes

retail in its latest incarnation. Paint Shop—which supports almost 40 file formats—boosts its power for image manipulation by adding support for multiple layers, including such functionality as comprehensive blend mode controls, layer grouping, naming, visibility, transparency locking, and variable opacity.

Other new features include CMYK color separations, unlimited levels of undo, a history of performed operations, a host of new image-editing and effects tools, and increased Twain, digital camera, and input-device support. An added bonus is the program's support for Photoshop files and plug-ins.—Melissa J. Perenson

RECAP PC Magazine reviewed nine image-editing packages in our issue of December 16, 1997. Microsoft Picture It! 2.0 was awarded the Editors' Choice.

Trends Peripherals

MULTIMEDIA PROJECTORS

Lights, Camera, LCD

It's the most important presentation of your career, and the best you can come up with is a PowerPoint file on your laptop. Your slides look great, but six executives huddled around your 12.1-inch display do not. Short of lugging around an oversized monitor, is there any way to save your career? Today's video-and-data projectors may be the answer.

NEC Technologies (800-632-4636, www.nec.com) is expanding its line of multimedia projectors with the \$7,495 **MultiSync LT80**. Through a partnership with Texas Instruments, the MultiSync LT80 uses TI's Digital Light Processing (DLP) single-chip display technology instead of the more

common LCD approach. Weighing a mere 9.8 pounds, the MultiSync LT80 boasts a brightness level of 600 ANSI lumens and a top resolution of 800-by-600; features include manual zoom and focus controls as well as a remote control laser pointer.

From Sony Electronics comes the \$9,990 **VPL-X600U** (800-686-7669, www.sony.com/professional), an XGA-resolution LCD projector that weighs 12.8 pounds and presents images at a brightness of 600 ANSI lumens. It can automatically sync to resolutions of 1,024-by-768, and its Auto-Pixel Alignment technology adjusts for prime imaging when connected to any computer signal source.

Sharp Electronics Corp. (888-523-7427, www.sharp-usa.com) responds to the competition with its



BRIGHTER CHOICES: (clockwise from bottom left) Sony's VPL-X600U, CTX Opto's EzPro 600, Panasonic's PT-L555U, Sharp's Notevision2, NEC's Multisync LT80, and Panasonic's PT-L795U.

\$7,495 **Notevision2 (XG-NV2U)**. Building on its earlier Notevision projector, the Notevision2 is markedly brighter (700 lumens) and lighter (12.9 pounds) than its predecessor. Sharp's proprietary ImageACE compression technology promises enhanced SVGA-to-XGA image conversion, and the unit's zoom/focus lens permits full-screen display on even the largest screens.

There are two new entries to the market from Panasonic Broadcast & Digital Systems Company: the \$9,999 **PT-L795U** and the \$5,495 **PT-L555U** (800-524-0864, www.panasonic.com/PBDS). At 600 lumens and just under 20 pounds, the PT-L795U gives you 1,024-by-768 uncompressed XGA resolution; computer graphics can project at resolutions up to 1,280-by-1,024. It also features a digital edge-correction function that clarifies poorer-quality images. Meanwhile, the 11-pound PT-L555U has a brightness of 450 lumens and 800-by-600 resolution.

Its built-in PC Card flash memory system lets you give presentations without being tethered to a PC.

From CTX Opto (800-433-5590, www.ctxopto.com) comes the \$6,495 **EzPro 600**, which can project uncompressed images at SVGA resolution and compression at up to XGA resolution. The device weighs 12 pounds and has a brightness of 550 lumens. —Stephanie Lindenbaum

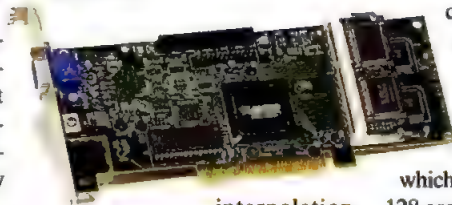
RECAP We reviewed five XGA LCD projectors in the First Looks section of our issue of November 18, 1997. Our Editors' Choice winner was the Proxima DP9200. We also reviewed 13 VGA units in our August 1997 issue. The Editors' Choice went to the Epson PowerLite 5000.

GRAPHICS CARDS

Fast, Smooth Video

Itching for more clarity and acceleration in your Windows applications and 3-D games? The latest models from graphics board vendors are ready to give your software titles the burst of energy they've been needing.

New from STB Systems (972-234-8750, www.stb.com), the \$199 **Lightspeed 3D** is based on Intel's new i740 graphics chip set. Designed to provide 2-D, 3-D, and live-action video acceleration, the chip set bundles a 64-bit graphics engine and a 203-MHz RAMDAC, allowing the card to support resolutions of up to 1,600-by-1,200. STB's board also includes 4MB of 100-MHz SGRAM (expandable to 8MB) as well as Intel's pixel-based



SUPERCHARGED: STB's new Lightspeed 3D graphics card.

interpolation scheme, which is designed to improve both 3-D scene quality and effects.

Targeted at PC power users and 3-D gamers is Hercules Computer Technology's **Hercules Thriller 3D** (800-323-0601, www.hercules.com). This 2-D/3-D card is based on the Rendition V2200 3D graphics processor and is available in either 8MB (\$249) or 4MB (\$129) versions. The card supports true

color at up to 1,152-by-864 resolution and has a maximum resolution of 1,600-by-1,200. The card also comes with a VESA-compliant stereoscopic connector for 3-D glasses.

The latest from Canopus Corp. (408-954-4500, www.canopuscorp.com) is the \$249 **Total 3D 128V**, which is based on nVidia's RIVA 128 graphics engine. As with the Intel i740, the RIVA chip set has a 230-MHz integrated RAMDAC and 4MB of 100-MHz SGRAM. The card supports resolutions of up to 1,600-by-1,200 at a refresh rate of 85 Hz and features such graphical capabilities as hardware scaling and color-space conversion. Bundled software includes Micrografx's Simply3D 2 LE and Kai's PowerGoo SE.

The successor to Diamond Multimedia Systems' (800-468-5846, www.diamondmm.com)

popular Monster 3D card is the \$249 **Monster 3D II**. Targeted at the PC gaming market, this 3-D-only card works in conjunction with your existing graphics card to deliver powerful acceleration for 3-D titles. The card, which features 6MB DRAM (2MB for display and 4MB for texture memory), is built around 3Dfx's Interactive Voodoo 2 chip set. The card supports resolutions of up to 800-by-600 (or 1,024-by-768 with the Scan Line Interleave option). The Monster 3D II supports Direct3D and Glide and Open GL APIs, and it includes a bundle of 3-D-enhanced titles to show off the card's abilities.

—Roderick A. Beltran

RECAP PC Magazine reviewed 23 graphics accelerators in our issue of December 2, 1997. We awarded our Editors' Choice to units from ATI, Number Nine, and STB.

Going faster than the other guy
It's a prerequisite. Running the
hottest, most challenging of all



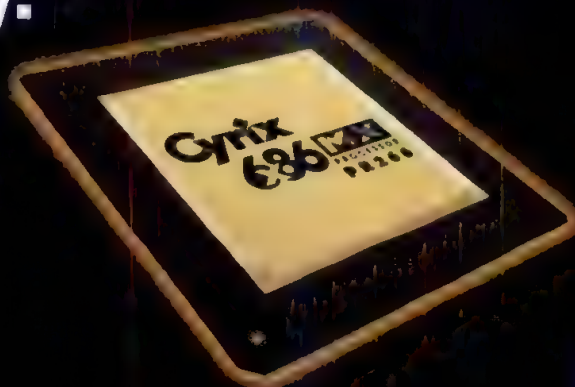
Having the
when you want and
It's an absolute. And having it
leg isn't a pipe dream. Today it's
Because you are a **rebel** with a

Shorter is faster.
Winstone 98 for Windows 95.



Cyrix Configuration: Microstar MS5164 Motherboard; ALI 1531 Chipset; Quantum Fireball ST43A013 disk drive; Diamond Multimedia Viper V330 PCI Graphics Card w/4MB SDRAM (driver rel. VP0015P); 1024x600. The Pentium II was tested on an ASUS P2L97 motherboard and the Trilon 440LX chipset. Cyrix is a registered trademark and 6x86MX is a trademark of Cyrix Corporation. Windows 95 is a registered trademark.

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latest, greatest,
software programs isn't nice.
It's **mandatory.**
power to do what you want,
how you want isn't unrealistic.
all without paying an arm and a
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resolution (16M colors at 75MHz); 32MB SDRAM RAM; 512K pipeline burst; 33MHz PCI bus speed. All systems tested using identical configuration with one exception:
of Microsoft Corporation. All other brand or product names are trademarks or registered trademarks of their respective holders. © 1996 Cyrix Corporation. All rights reserved.

SEARCH ENGINES

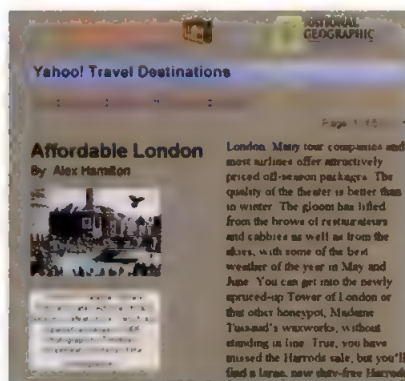
Seeking Out Info on the Web

If you've settled into using the same search site over and over again for your Web needs, you might have missed some new content resources available on other popular sites.

Northern Light has recently added more than 1,000 publication titles to its special collection of full-text periodicals, which are unavailable elsewhere on the Web (www.northernlight.com). The special collection costs nothing to search, but full-text articles range from \$1 to \$4. Among the new publications available are the *Atlantic Monthly*, *The Economist*, and *Rolling Stone*. Other academic, business, and consumer titles, as well as over 150 newspapers, have also been

added. With these new additions, Northern Light now offers a repository of 2,900 periodicals.

Over at the ever-popular **Yahoo!** (www.yahoo.com), there are two new content partnerships. First off, Yahoo! has teamed up with the magazine *National Geographic Traveler* to provide information about cities around the world and in the United States from articles originating in the magazine. The new articles can be found under the "Featured Article" area within many of the city categories on Yahoo! Travel. There are currently more than 75 articles about cities and places such as Copenhagen and Banff National Park in Canada. The articles include information



EXPANDED FEATURES: New resources are now available at Yahoo!

about local cuisine, residents, and main attractions. Meanwhile, in the entertainment arena, Yahoo! has expanded the reach of its television listings through its recent partnership with TV listings site Gist (www.gist.com).

Excite (www.excite.com) has teamed up with Ziff-Davis's

ZDNet to provide computing and Internet content for the Computers & Internet Channels on both Excite's and Webcrawler's sites (www.webcrawler.com). ZDNet will provide breaking news, product reviews, downloadable software, and special news features. Joint online promotions are also planned. From the channel, consumers can shop for computer equipment and software, access freeware and shareware services, get help for their computer-related problems, and more.—Doug Beizer

RECAP We reviewed 12 search indexes and directories in the issue of December 2, 1997. HotBot and Yahoo! were given Editors' Choice awards.

UTILITIES

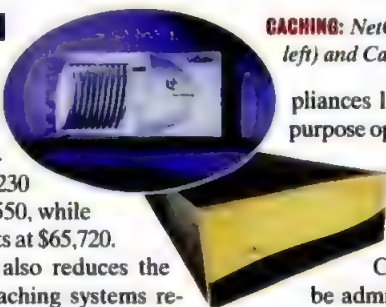
Net Improvements

With more and more businesspeople using the Internet for work, the need for solutions to speed up response times continues to grow. Caching copies of Web content on your networks is one way to improve your business Internet time. Here are some of the latest hardware caching systems that you can add to your network.

The **NetCache** family of network cache appliances, from Network Appliance (888-852-2996, www.netapp.com), provides network administrators with a means of reducing traffic, improving user response time, and enhancing security. In lieu of software, NetCache uses a single integrated box designed specifically to decrease bandwidth limitations on an orga-

nization's Internet. The C230 starts at \$16,550, while the C630 starts at \$65,720.

NetCache also reduces the number of caching systems required to support large-scale clustered installations. Unlike Web caching software, NetCache ap-



CACHING: NetCache (above left) and CacheFlow.

pliances lack a general-purpose operating system to tune, configure, or administer. Instead, NetCache boxes can be administered using any browser-based tools from anywhere on a network. According to Network Appliance, the

C230 and C630 can handle peak loads with 20-ms response times over 80 percent of the time.

Offering a scalable, rack-mounted hardware and software solution is CacheFlow (650-849-1400, www.cacheflow.com). The company's **CacheFlow 1000** accelerates the delivery of Web pages to end users within an enterprise and maintains cached pages in anticipation of their access. Equipped with 8GB of disk storage, CacheFlow starts at \$39,500; with a whopping 25GB, the device starts at \$47,700.

Unlike more passive techniques, CacheFlow 1000 automatically and adaptively keeps cached Web pages up-to-date in order to deliver them upon request. No hardware configuration and only minimal software configuration is required. CacheFlow can serve hundreds of users accessing Web servers both inside and outside your business.—DB

Help for Finding Your Domain

As companies scramble to secure Internet addresses and domain names, services have become available to help them achieve this.

Recently, [websitenames.com](http://www.websitenames.com) (888-881-2255, www.websitenames.com) established **.com Exchange**, an Internet trading center for commercial Net addresses. The Exchange's name bank contains over 800 available .com domain names, which can be searched by general category (such as entertainment, services, or media) or specific category (such as air travel, insurance, or video).

Companies that already have a domain name can "point" more than one domain to their

Web site with multiple Internet addresses.

Site developers not yet ready to launch can buy their dream domain name and "park" it for future use. The Exchange's average listing price per domain name is under \$3,000.

NetNames' global domain name service (888-638-6263, www.nic.tm) recently launched a new Internet domain: **.TM**. The Web site features a searchable registered names server.

Domain names are available on a first-come, first-serve basis and each cost \$50 per year. The fee covers real-time name registration and all necessary modifications for the rest of the calendar year.—Emily Cohen



Rodéo 5000 SERIES



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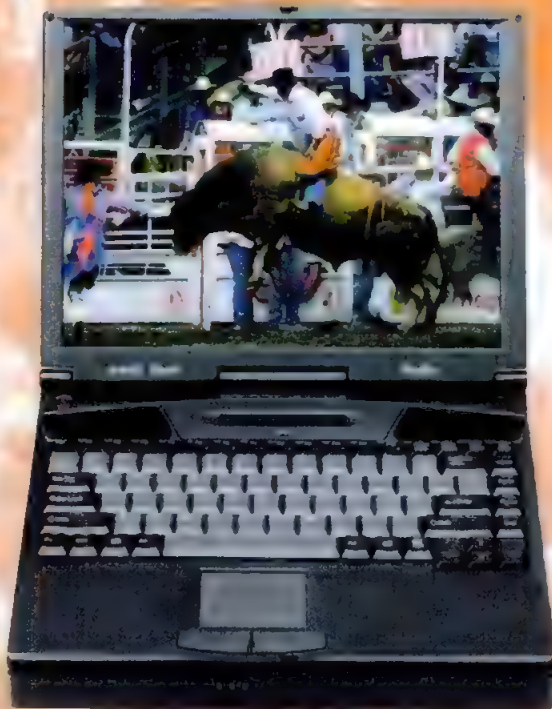
More viewing area than a 15" desktop monitor.

3D Graphics

With 4MB of video RAM deliver full screen full-motion video, real-time animation and 3D capabilities.

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EDITORS' CHOICE

The AMS Tech Rodéo 5030ECX won Editors' Choice in a test of 21 top-of-the-line notebook computers. The Rodéo 5030ECX finished first in the BAPCo SYSmark32 suite, which tests real-world business applications and came in second in the Intel Media Benchmark suite, which tests multimedia performance.

**Computer Reseller News
February 2, 1998**

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Intel Mobile 266MHz Pentium® Processor with MMX™ Technology
Processor upgradable to Pentium® II Processor.

All-in-One System
CD-ROM and Floppy Drive are able to work together at the same time.

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Mo.#	Pentium® Processor with MMX™	Hard Drive	Base/Maximum RAM	Screen Size	Fax/Modem	CD-ROM Drive	Est. Street Price*
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5020ECX	233MHz Pentium® Processor	4.0GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3895.00
5010ECX	233MHz Pentium® Processor	3.1GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3795.00
5000ECX	233MHz Pentium® Processor	3.1GB HDD	32/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3595.00
3040ECX	266MHz Pentium® Processor	4.0GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	24X CD-ROM	\$3995.00
3030ECX	233MHz Pentium® Processor	4.0GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3895.00
3020ECX	233MHz Pentium® Processor	3.1GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3795.00
3015ECX	233MHz Pentium® Processor	2.1GB HDD	32/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3495.00
3010ECX	200MHz Pentium® Processor	3.1GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3395.00
3000ECX	166MHz Pentium® Processor	3.1GB HDD	32/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3295.00

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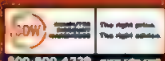
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MESSAGING

Centralized Access

One of the ironic hassles of the Information Age is scattered information. After all, we have numerous voice mailboxes, fax numbers, pagers, and e-mail accounts—all of which contain vital information we need. Thankfully, there are several new products that help centralize our information retrieval.

Ring Zero Systems' (650-349-0600, www.rzs.com) **Video Central** provides an integrated repository for voice, text, and video messages. It can send and receive voice-over-IP telephone calls, Internet faxes, and H.324 videophone messages.

The videophone messages can run at up to 20 frames per second over POTS lines and include real-time chat and whiteboard functions. Video Central also includes a text-to-speech engine that lets you listen to your e-mail over the phone and merge a fax, voice, or data message into an e-mail.

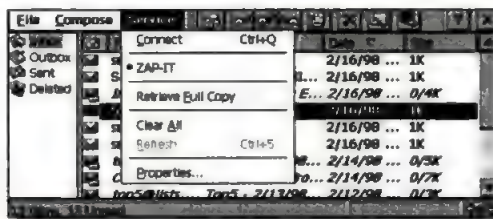
Video Central also includes universal mailbox messaging, so you can set your mailbox to answer one type of call or receive only specific kinds of messages (voice, fax, or data). Re-

tail pricing was unavailable at press time.

Zap-It, from DTS Wireless (888-243-8337, www.dtswireless.com), can assist road warriors who want one-stop messaging. It offers instant wireless access for

Not only does Zap-It handle e-mail, it also receives faxes, pages, and voice messages via a single 800 number. Outbound faxing can include signatures, letterheads, and file attachments. You can even record outbound voice messages with built-in text-to-speech technology.

Zap-It works with Microsoft Windows 95, Windows CE, and Palm PC; a Palm Pilot version is in the works. There is a one-time \$19.95 set-up fee for e-mail, and Zap-It offers



FROM THIN AIR: Using Zap-It, you can access and send e-mail wirelessly from your Windows CE system.

laptop and palmtop PCs and works in conjunction with existing e-mail accounts to provide a single mailbox solution.

a wireless modem for only \$300 (\$24.95 a month) with its annual personal contract. —Michael N. Rusignuolo

REMOTE ACCESS

Away From Home

If you're feeling under the weather or you're a road warrior on a call, remote access software can help keep you in touch with the office, especially since dial-in products can give you access not only to your desktop system but to your entire corporate network.

Traveling Software (800-343-8080, www.travsoft.com) offers inexpensive remote-access software with its \$49.99 **Remote DeskLink**. Configured for easy setup, the program can automatically configure your modem and network devices for remote ac-

cess and remote Windows 95 machines, you're ready to work. In order to avoid big personal phone bills for doing work at home or on the road, you can use a DeskLink feature that makes your office computer call you back to re-establish a remote connection—on your corporate phone bill.

Remote DeskLink is also the first product to include Absolute Software's theft-recovery software CompuTrace. DeskLink customers get free activation and three months free access with each \$59.99 annual subscription. Upgrades to Traveling Software's LapLink are also available for only \$89.99.

Stampede Technologies (937-291-5035, www.stampede.com) is offering a corporate product with **Remote Office Gold 5.0**. Remote Office Gold is business-level, remote-

provides client-side software for remote users.

Version 5.0 of Remote Office Gold includes SofToken, from SafeWorld, which increases the program's security. Remote Office Server Gold works with Windows 3.x, 95, and NT, but Version 5.0 also operates with Microsoft

NT Remote Access Servers (RAS). The new version can dynamically assign Domain Name Servers and Windows Name Servers within RAS.

User licenses are \$540.95 per user for ten-user increments, \$39.95 for 100 users, and \$20.95 for 1,000 users.—MNR



INSTANT ACCESS: Remote Office Gold helps you connect to your corporate network.

cess. It supports TCP/IP and IPX networks and Windows 95 Dial-Up Networking.

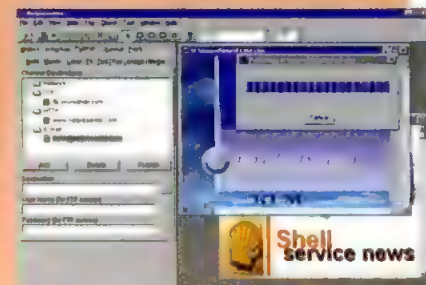
Once you install Remote DeskLink on both your local

A Corporate-Friendly Push

Although some push services suffer from criticism because of their large system and network demands, **Netpresenter 3.0**, from Netpresenter B.V. (408-490-2857, www.netpresenter.com), offers a corporate push service that features a small client footprint and low network bandwidth usage.

The Netpresenter client works as an interactive screen saver; you can simply view the online channels or click on hyperlinks to go to Web sites set by your administrator. In addition, you can use the Intratext Server to enter messages and updates to the online channels, or you can use the Teletext Server to view broadcast news services such as CNN or AP News (where available). Each client player runs on only 150K, and Netpresenter claims that its network load is only 5 to 10 percent that of Pointcast.

Version 3.0 of Netpresenter introduces the Webform, a feature that helps make global messaging more efficient. This "smart screen" message can include scheduling information and hyperlinks to nested presentations. Netpresenter is available for Microsoft Windows 3.x, Windows 95, and Windows NT at a list price starting at \$799 for one editor and 20 players.—Stephanie Lindenbaum



Low cost video editing and much more!



Handy with a video camera? Got tons of video footage just waiting to be dazzled with special effects, titles and sound? Breathe life into your home videos using the Matrox Rainbow Runner Studio.

This video editing upgrade module for the Mystique series and Millennium II graphics accelerators lets you create and edit just like a pro.

Revamp home movies with Hollywood-style transitions, outrageous or elegant titles, and sound bits that will bring just the right touch to those special moments in your life. Video conference with family and friends over the Internet. Grab video and make customized greeting cards and calendars. Play your favorite PC games on your big screen TV, and much more!

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October
1997



January
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February
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Matrox Rainbow Runner Studio

- Ideal for video and image editing, video conferencing, PC to TV output, hardware MPEG video, and more
- Video upgrade module for Matrox Mystique, Mystique 220, and Mystique 220 Business graphics accelerators
- Separate upgrade for Matrox Millennium II

\$199 for the Matrox Mystique Series

\$229 for Matrox Millennium II

Matrox Rainbow Runner TV

- Watch or record TV on the PC
- Program your PC to scan TV shows
- Fully programmable with PC-VCR Remote
- Must be used with Matrox Rainbow Runner Studio

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How much longer? Our VisionMaster 450, for example, has a Mean Time Before Failure (MTBF) of 46,900 hours. This equates to 23.4 years of life when used in normal business applications.** So that monitor you just bought could very well be used to put your teenage son through college and his son through high school.

This philosophy of building high-quality, long-lasting products goes into everything we do. Take USB for example. Other manufacturers make their customers buy a new monitor if they want the latest technology (like USB) integrated into their monitors. (Perhaps this is because after three years they need a new monitor?) iiyama has designed a convenient and cost-effective upgrade solution — a USB hub that replaces the user's existing tilt/swivel stand.

It is due to innovations like these and a unique devotion to quality that makes iiyama monitors so reliable.

VisionMaster 450 \$899*



Model/ Viewable Area	Dot Pitch/ CRT Type	Max. Horizontal Scan Rate	Max. Resolution	Est. Street Price
VisionMaster Pro 500 (19.5" VHS)	0.28mm/AG		1800 x 1440	\$1379
VisionMaster 500 (19.5" VHS)	0.27mm/dp	110kHz	@ 74kHz	\$1329
VisionMaster 450 (18.0" VHS)	0.26mm/ High Contrast	102kHz	1600 x 1200	\$899
VisionMaster Pro 17 (16.1" VHS)	0.25mm/AG	92kHz	1600 x 1200 @ 74Hz	\$649
VisionMaster 17 (16.1" VHS)	0.26mm/dp	86kHz	1600 x 1200 @ 69Hz	\$589

*Monitor shown with optional USB hub. (\$130 ESP)



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January 6 1998
VisionMaster Pro 17



Perfect Five-Star Rating
January 1998
VisionMaster 450
VisionMaster Pro 500



Perfect Five-Star Rating
November 1997
VisionMaster Pro 17



Performance & Technical Excellence
March 1997
VisionMaster Pro 21



Six Time Winner
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April 1997, May 1997, June 1997
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First Looks



Dawn of a New Video Age

New parallel-port video input devices make capturing motion and still images from any video source easier and more accessible than ever.

By Jan Ozer

Until recently, the marriage between computer and camcorder was consummated solely with a screwdriver, which you needed in order to open the computer case and secure a board in an expansion slot. But today, if you can find your parallel port, you can capture full-motion video, produce MPEG-1 files, and capture still images from your camcorder or any other video source, all for under \$400.

SNAP THIS

These parallel-port products fall into two categories: frame grabbers, which capture still images and AVI video files, and MPEG-1 capture devices, which also capture still frames.

Dominating the frame-grab-

ber market is Play's \$140 Snappy 3.0 Deluxe, which is the third-generation progeny of the original Snappy that pioneered the parallel-port video market in 1995. Also reviewed is ArcSoft's frame-grabber unit, the \$130 Zipshot.

We looked at four MPEG-1 encoders: AVerMedia's MPEG Wizard, Dazzle Multimedia's Dazzle, FutureTel's Video Sphinx Pro, and Videonics' Python. At first glance, the four MPEG-1 encoder units appear very similar. All are AC-powered parallel-port devices with S-Video and composite video inputs. All produce MPEG-1 files in quarter-screen resolution for CD-ROM distribution as well as postage stamp-size files for online viewing. You can adjust

the brightness, contrast, and color balance of incoming video on all products as well as incoming audio levels. All snap still-frame pictures, and several function as AVI capture devices for use with software such as Microsoft's NetMeeting.

HOW WE TESTED

We compared the performance and output quality of all six devices by capturing a mix of talking-head and action videos. In addition, we captured 20-minute talking-head clips with the four MPEG-1 encoders in order to check audio-visual synchronization.

So how do you choose among the four MPEG-1 devices? As you would expect, our tests revealed significant differences in video and still-

INSIDE

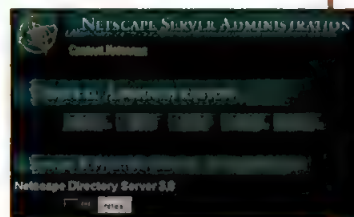
POCKET NET:

Novatel's Minstrel Wireless IP Modem will take your PalmPilot to the Internet. For the review, see page 56.



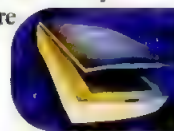
GROUP WEB:

Netscape's SuiteSpot 3.5 will change the way companies look at the Web and groupware. See page 62 for the review.



NOT JADED:

LinoColor's JADE2 scanner and ColorFactory Pro software make an excellent combination. See page 76 for the full story.



More Products Reviewed...

IntelliSync for Palm Pilot 2.0	56
PackRat Pro 6.0	66
Toshiba TLP-511A	
MediaStar	66
Lexmark Optra S 1620n	68
Applica U2	73
Jasmine Developer Edition 1.0	73

First Looks Online

For daily just-in-time reviews of shipping products, check out First Looks Online at www.firstlooks.com



First Looks

image output quality. Not all of the units supported the 320-by-240 square-pixel output that prevents MPEG-1 videos from looking stretched when displayed on computer screens. In addition, one product failed our 20-minute synch test, which is obviously important for those who produce longer videos. Also noteworthy was the ease of use and functionality of the bundled software, particularly with respect to MPEG-1-related features such as cut-and-paste editing.

As for the two frame-grabber units, our tests revealed that each provides an interesting mix of features—not to mention different output quality. In the end, we found that while you can have convenience or top quality, you cannot get both in the same product.

Obvious throughout our tests was the fact that these external units are worlds easier to install than their PC-bus-based ancestors; they're also much less expensive. So no matter which product you choose, you'll find that this class of parallel-port devices makes digital video accessible to even the most PC-phobic video enthusiasts.

ArcSoft Inc.

Zipshot

Although ArcSoft's Zipshot (\$130 street) offers some attractive hardware features, output quality is lacking.

Slightly larger than a pack of cigarettes, the Zipshot is powered by a keyboard pass-through connector, eliminating the need for batteries. The unit accepts S-Video and composite video input, offers composite video out, and features a parallel-port pass-through connector. The Zipshot's software bundle includes Twain and video-capture drivers, ArcSoft's PhotoImpression image editor, and multimedia e-mail and video-conferencing programs.

All images are captured from within PhotoImpression using the Zipshot proprietary driver. The driver has a modern look and feel, but underneath the hood is a 16-bit application that lacks such 32-bit niceties as the ability to create new directories when saving files.

Still-image capture is available at five fixed resolutions, ranging from 320-by-240 to 1,600-by-1,200 in black and white or color. Video capture is limited to 160-by-120 and 320-

by-240 in black and white or color, with no control over capture frame rate, format, or audio parameters.

You can adjust the color and brightness for both still and video captures but not color or hue settings, which is important for many videos. The program offers two capture modes for moving and still scenes, but the latter mode invariably crashed our test PC, a problem that ArcSoft's technical support hadn't previously encountered. Though acceptable for consumers, most professionals will find the capture controls

Zipshot

Street price: \$130. Requires: 8MB RAM, 20MB disk space, Microsoft Windows 3.1, 95, or NT

ArcSoft Inc., Fremont, CA

800-702-8657, 510-440-5901

www.zipshot.com

Choose 408 at www.pcmag.com/infoink.

insufficient for industrial-strength work.

In some areas, the Zipshot puts the high-quality S-Video input to good use, producing crisp colors and backgrounds with less color smearing than the Snappy. Nevertheless, ArcSoft's image processing was clearly inferior to the Snappy's, evidenced by the "jaggies" apparent in most images.

In addition, pictures captured from slightly dark sources exhibited a streaky,

filmy appearance that obscured detail and marred image quality. Other than color fidelity, the only arena in which the Zipshot bested the Snappy was in cycle time, where the Zipshot averaged about 2 seconds to the Snappy's maximum of 30 seconds.

During video capture, the Zipshot appeared to capture without dropping frames at 160-by-120, but it dropped significant frames at 320-by-240. At both resolutions, videos were automatically encoded into Video1 format, which marred their appearance. Even though capture performance is probably sufficient for low-quality videoconferencing, it falls short of what you would



expect to find in a professional-quality video-capture system.

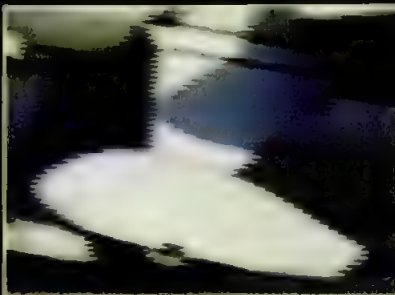
The ArcSoft Zipshot is one of a number of competitors that are seeking to unseat Play's Snappy 3.0 Deluxe from its still-image-capture throne. Even though the Zipshot comes closer than most, it falls short in the most critical area: image quality.

Side by Side

In this series of closeups, you can compare the still image capture abilities of the six products in this roundup.



ARCISOFT ZIPSHOT: Though not as clean as the Snappy's images, the Zipshot's images showed only the faintest of aliasing, and processing time was extremely short.



AVERMEDIA MPEG WIZARD: The MPEG Wizard's still image captures were clearly the worst of the bunch, with obvious interlacing artifacts throughout the picture.

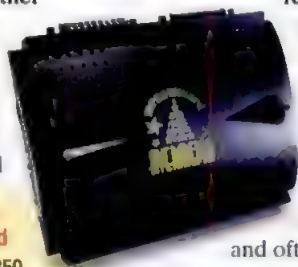


DAZZLE MULTIMEDIA DAZZLE: The Dazzle's motion captures showed faint interlacing artifacts along the strut and throughout high motion shots.

AVerMedia

MPEG Wizard

Compared with the other products in this roundup, AVerMedia's MPEG Wizard produces average-quality video as well as substandard still



**AVerMedia
MPEG Wizard**

Street price: \$350

Requires: 16MB RAM,
Microsoft Windows 95,
CD-ROM drive,
sound card

AVerMedia Technologies Inc., Fremont, CA

800-963-2332, 510-770-9899

www.aver.com

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frames. It also lacks support for square-pixel output, and it's saddled with the least friendly interface. Couple this with a \$350 street price, synchronization problems, and occasional unstable performance and you get a unit that's difficult for us to recommend.

The MPEG Wizard is a black, modem-size device with printer-port pass-through. AVerMedia ships the MPEG Wizard with several programs, most notably Cinax's MPEG-1 video editor iFilm Edit, Duplexx's Net Toob streaming MPEG software, and an AVI driver for compatibility with Microsoft NetMeeting.

The DigiVCR control program is a floating application

built around a preview and playback window. The AVerMedia unit supports two video-capture resolutions (not including 320-by-240), with a VideoCD preset.

The program's capture controls are primitive and often counterintuitive. For example, the capture button turns red after you start capturing, the reverse of other programs. And even though the program enables normal brightness, contrast, hue, and saturation adjustments, accessing this menu stops the video display, so you can't view your adjustments in real time.

After capture, you can call up iFilmEdit from the main capture window, but this merely loads a standalone version of the product; there's no integration between the two programs. Cinax's software provides bare-bones cut-and-paste editing, which is less functional than MPEG-1 editing facilities.

In low-light conditions, the MPEG Wizard's video looked blurry and was marred by slight fluorescent artifacts not present in other video clips. In outdoor settings, the video tended to look a touch faded and indistinct. The MPEG Wizard's talking-head performance was impressive, with very limited

Editors' Choice

• Video Sphinx Pro



The six products in this roundup perform two basic functions—still-image capture and MPEG

-1 encoding—all without popping the hood of your computer. If you need both functions, your best choice is FutureTel's Video Sphinx Pro (\$350 street), our Editors' Choice. The Sphinx's MPEG-1 output quality led the pack, and FutureTel's software interface clearly represents the most functional integrated production environment. In addition, the unit's still image capture quality was the best of all the MPEG-1 encoders.

If still-image capture is all you need, you probably won't go wrong with our Honorable Mention, Play's Snappy Deluxe 3.0, which for a mere \$140 (street) does the best job capturing artifact-free, moving images from a camcorder.

background artifacting and good detail, although the lack of square-pixel output caused some stretching.

Synchronization was accurate on our short tests, but the 20-minute video lost synchronization after about 5 minutes, even after we took the steps recommended by AVerMedia's tech support. In addition, the MPEG Wizard was our least stable unit, crashing occasionally on two different test systems.

The MPEG Wizard can capture still images in four fixed resolutions, ranging from 160-by-120 to 1,600-by-1,200 in BMP, GIF, and JPEG formats. You capture by first "freezing" an

image and then saving it; there is no multi-image capture capability. In terms of quality, the unit's still frames were marred by tiny venetian-blind interlacing artifacts, which were especially pronounced in motion shots. Low-motion shots were surprisingly clear, with good detail and low background noise, although again they were distorted by the absence of square-pixel support.

Though you probably won't be disappointed by the MPEG Wizard's video quality, it's a nonstarter for even moderate-motion still-frame captures. On the whole, you can find cheaper and easier-to-use units that produce better-quality output.



FUTURETEL VIDEO SPHINX PRO: The Video Sphinx Pro performed well in still image capture, with just a hint of aliasing visible along the wheel well.



PLAY SNAPPY 3.0 DELUXE: The Snappy's ASICs create the smoothest, least aliased image of the bunch at the cost of some slight fuzziness.



VIDEONICS PYTHON: The Python is competent at removing aliasing, but it captures only in JPEG format. Also, complex frames showed slight blockiness, a frequent JPEG artifact.

First Looks

Dazzle Multimedia Inc.

Dazzle

At \$199 (list price), Dazzle Multimedia's Dazzle is a great choice for consumers seeking a functional, inexpensive MPEG-1 encoder for their personal videos that also offers adequate snapshot capabilities.

Dazzle features a printer-port pass-through but lacks on-board audio, which instead is captured by the system sound card. In addition to Dazzle's capture interface (called Amigo), the unit is bundled with several programs and drivers (Cinax iFilmEdit) as well as an AVI driver for compatibility with Microsoft NetMeeting.

Amigo is a simple, oval program built around a preview/playback window. The software has all the usual features, such as incoming video adjustments and multiple output resolutions (including 320-by-240). In addition to a VideoCD preset, you can choose between three capture data rates—low, medium, and high—or enter a custom value.

On the whole, the Dazzle interface was designed for form first and function second, and easy access to features takes a clear back seat to maintaining the integrity of the oval-shape design. For example, the Dazzle eschews VCR-

type controls for capture and playback buttons that are awkwardly placed on the right-hand edge of the oval. In addition, frequently used controls for incoming video adjustment and audio volume are buried under menu items. The result is a program long on style and short on usability.

After capture, you can trim frames and combine clips in i-FilmEdit, itself a crude but functional editor. For example, there is no slider bar or frame-advance function to assist you when editing in and out points. Instead, in order to find your in and out points, you have to play the video and press pause when you get to the desired frame, which is both frustrating and inaccurate.

In general, the Dazzle's video looked filtered, which reduced background noise and artifacting but blurred foreground objects and detail. In low light, the Dazzle's video became filmy, while outdoor footage appeared slightly faded. Colors were sharp in our talking-head clip, although facial features were a bit blurred. The Dazzle passed the 20-minute synchronization test without a

problem, and it produced good quality sound.

The Dazzle offers still-frame capture in a range of resolutions up to 1,600-by-1,200, with storage in several formats (such as BMP and JPEG). Capture controls are simple, but it's easy to overwrite previously captured images by accident. Although the Dazzle has a moving capture option, motion artifacts were prevalent



Dazzle

List price: \$199

Requires: 16MB RAM, 12MB disk space, Microsoft Windows 95, ECP or EPP parallel port.

Dazzle Multimedia Inc., Fremont, CA

888-436-4348, 510-380-2300

www.dazzlemultimedia.com

Choose 410 at www.pcmag.com/infoink.

in all moving images. On the other hand, low-motion shots were less noisy than other MPEG-1 capture devices here, though they were not as clear as the dedicated frame grabbers.

On the whole, the Dazzle offers lots of value to casual users seeking MPEG-1 and still-frame capture at an extremely affordable price, but you should expect your high-motion snapshots to suffer from obvious aliasing. Users in production environments, however, will be much better off with the more function-

al, integrated tool sets offered by other products.

FutureTel Inc.

Video Sphinx Pro



With both on-board audio and an integrated production environment, FutureTel's Video Sphinx Pro (\$350 street) is the best bet for both amateur and professional video producers, especially those looking for a long-term solution. Though the first release is highly functional and produces great quality video, it suffers from some irritating flaws, including the lack of a video preview option.

The Sphinx doesn't have a printer pass-through port, which is a hassle if you frequently print from your capture station. Also, the unit requires an ECP parallel port, so you should check your CMOS setup for this capability before buying. The Sphinx's control program supports still and video capture and cut-and-paste video editing, and it provides multimedia database and presentation programs. Bundled programs include MetaCreations' Kai's Power Soap and Macromedia's BackStage.

Capture is initiated with VCR-like controls, but this version has no prevideo-capture preview function. Nevertheless, you can use the still-image capture preview to make your color and

Frozen in Time

Compare the MPEG-1 talking-head video capture abilities of the four MPEG products in this roundup.



MPEG WIZARD: The MPEG Wizard's talking-head performance was impressive, but it was also marred by the lack of square pixel output.



DAZZLE MULTIMEDIA DAZZLE: Note the lack of crispness in the Dazzle's facial features, which may indicate precompression filtering.



FUTURETEL VIDEO SPHINX PRO: Though the Sphinx's video was a touch noisier than some others, foreground features were extremely crisp.



VIDEONICS PYTHON: The Python's video showed great contrast and clarity, but also stretching from the lack of square pixel output.



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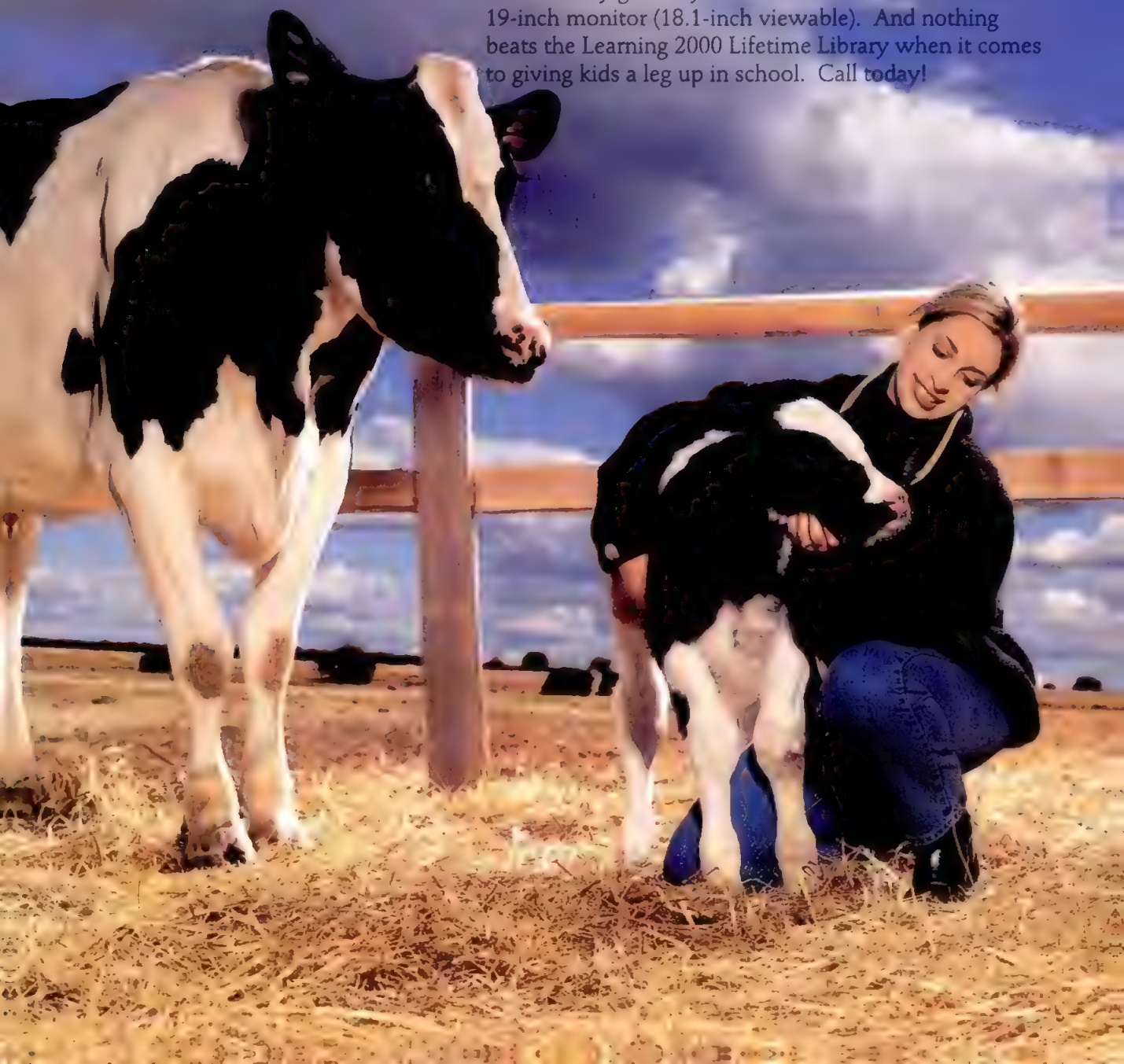
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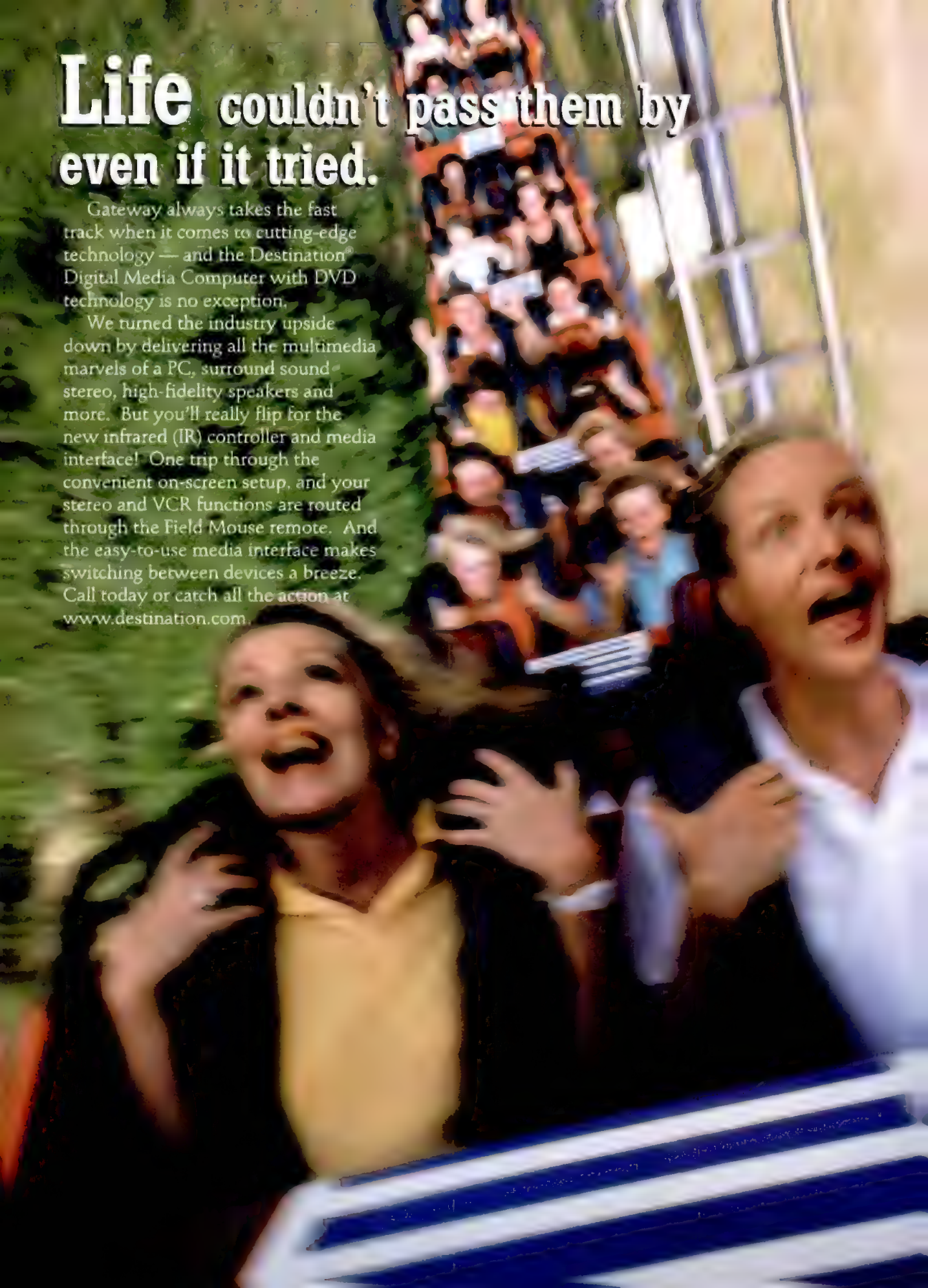
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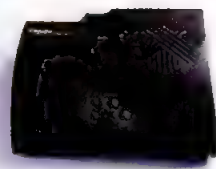
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First Looks

brightness adjustments. Video capture resolutions range from 160-by-112 to 352-by-240, including 320-by-240. After capture, you can trim unwanted frames in a trim panel with absolute frame accuracy and then merge separate MPEG-1 clips in the ClipGlue window.

From an interface standpoint, this program has some attractive touches, including collapsible incoming audio and video adjustment panels on the main capture window. On the other hand, functions that should be obvious are often obscure, and we actually had to check the help files to discover how to save a video or still-frame bitmap after capture. Although the Sphinx's feature set is both broad and deep, beginners—and especially experts used to more conventional designs—will likely find the program unintuitive at the outset.

In terms of quality, the Sphinx's clips were sharper than those of the other products. Unfortunately, they were also slightly noisier, a characteristic that was more pronounced in our low-light clip. Still, the talking-head clip was stunning in its detail and facial contrast, and it was marred only by infrequent background noise. Given the Sphinx's on-board audio capture, it wasn't surprising that the unit maintained solid synchronization on all tests.

The Sphinx has a good interface for multibitmap capture. Successive shots are sent to a filmstrip beneath the capture window, where they can be saved at up to 1,600-by-1,200 resolution in JPEG, BMP, TIFF, and PCX formats. The Sphinx doesn't support square-pixel still-image capture, but you can easily adjust for this using an editing program. On the whole, the Sphinx's images were slightly noisier than those of other MPEG-1 devices, but mo-

tion handling and color quality were adequate.

The only product supplying both square-pixel video output and frame-accurate editing, the Sphinx is the only real choice for serious video producers. Still-frame quality, though not

Video Sphinx Pro

Street price: \$350

Requires: 16MB RAM, 20MB disk space, Microsoft Windows 95, CD-ROM drive, ECP parallel port

FutureTel Inc., Sunnyvale, CA

888-775-4652, 408-522-1400

www.sphinx2.com

Choose 411 at www.pcmag.com/infolink.

up to the Snappy's levels, is more than adequate. Just plan on a short but steep learning curve.

Play Inc.

Snappy 3.0 Deluxe

Play's Snappy 3.0 Deluxe has achieved legendary success in the still-image capture market, and the new deluxe version (\$140 street) should continue this legacy. Be forewarned, though: The Snappy's success relates more to quality than convenience. Also, the new video-capture capabilities are better suited for hobbyists than professionals.

The Snappy ships with an updated capture interface, an image editor, Adobe PhotoDeluxe 2.0, MetaCreations' Kai's Power Goo SE, and Gryphon Morph; composite video and stereo audio cables round out the bundle. The hardware itself is unchanged from previous versions, and thus it retains the same three limitations. The Snappy is still battery powered and has no AC or keyboard option, and it still lacks parallel-port pass-through, a hassle for the user who frequently captures and prints from the same machine. The Snappy also accepts only com-

posite input, whereas all of the other units in this roundup support the higher-quality S-Video signal as well.

Along with video capture, the new capture interface debuts a color preview, audio capture, and a high-definition capture mode. You can capture at any arbitrary resolution ranging from 160-by-120 to 1,500-by-1,125 in either black and white or color, with adjustments for color, brightness, contrast, sharpness, tint, or RGB values of the incoming video.

There are four image-capture modes (single still, continuous, time lapse, and movie capture) and four video-source options (moving picture, still picture, very still picture, and high-definition still) that customize capture settings for your source video. Generally, the new interface is functional, but it is less intuitive and slightly more unresponsive than in previous versions, especially in terms of the new help section.

During capture, the Snappy uses custom ASICs to process the image, removing obvious NTSC artifacts like jaggies. This enables the Snappy to produce artifact-free images with finely preserved detail, particularly at high resolutions (where the Zipshot's images looked streaky with noticeable jaggies). The only downside is cycle time, since the Snappy takes about 30 seconds to snap and process a picture in highest quality mode (13 seconds in normal quality), compared to the Zipshot's 2.

In other quality metrics, the Snappy's images also exhibited higher contrast than the Zip-

shot's. This was especially true on portraits, where the device produced more realistic-looking faces. Nevertheless, the Zipshot's images suffered less background-color smearing than the Snappy's, probably due to the higher-quality S-Video input.

On the downside, the Snappy dropped frames while capturing video, even on 160-by-120 captures. Also, it lacked such common controls as video frame rate and audio capture parameters. Though it produces reasonable-quality images, the Snappy shouldn't be considered for professional video-capture projects.

Since introducing the Snappy, Play has stubbornly resisted updating its base hardware unit for quality-related and convenience features. Although this detracts slightly from the Snappy's potential, the unit still represents the highest-quality option for snapping still images from a camcorder.

Videonics

Python

Videonics' Python (\$350 street) boasts an intuitive, engaging interface and produces excellent-quality video and good-quality still frames. The only flaw is the lack of square-pixel MPEG-1 output, which may prove annoying to CD-ROM title developers or even casual users.

The Python is a futuristic-looking device with printer pass-through; audio capture is handled by the system's sound card. The product ships with Xing's StreamWorks Server, MetaCreations' Kai's Photo Soap SE, and Astound's presentation package, Astound 4.0. There's also an AVI capture driver for compatibility with Microsoft NetMeeting.

Snappy 3.0 Deluxe

Street price: \$140

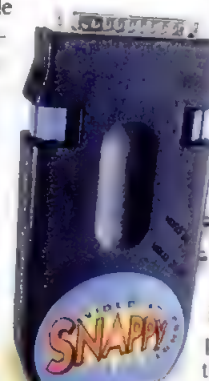
Requires: 8MB RAM (16MB for Windows NT), 8MB disk space, Microsoft Windows 95 or NT 4.0

Play Inc., Rancho Cordova, CA

916-951-0800

www.play.com

Choose 413 at www.pcmag.com/infolink.



First Looks

The Python's control software provides five functions: MPEG-1 capture, still-frame capture, videoconferencing, and the ability to output your video to Web pages and e-mail. Videonics has made frequently used controls extremely accessible by placing both incoming video and volume adjustments on the main panel.

You capture images and videos using VCR-like controls in 352-by-240 and 160-by-120 resolutions (but not 320-by-240). There are five data transfer rate options, from smallest file to highest quality. These ranged from 100 to 187 KBps at 352-by-240 resolution. New in Version 1.2 is a Video CD preset, which is useful for developers targeting that format. Other noteworthy capture options include a comb filter for poor-quality source videos and the ability to set under-the-hood MPEG-1 parameters like GOP (group of picture) size.

After capture, you are able to trim unwanted frames, but all edits must occur on an I-frame. This limits accuracy to within about half a second. Also useful is the ability to ap-

pend multiple files into a single composite clip. Overall, the program is functional, intuitive, and appropriate for any skill level.

Videonics Python

Street price: \$350

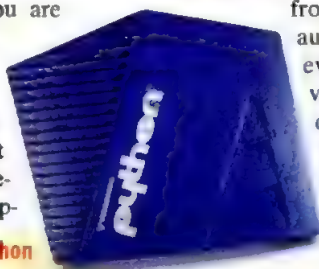
Requires: 16MB RAM, 50MB disk space, Microsoft Windows 95, CD-ROM drive, sound card, SPP parallel port

Videonics Inc., Campbell, CA

800-338-3348, 408-866-8300

www.videonics.com

Choose 414 at www.pcmag.com/infolink.



When we performed our initial tests, the Python suffered from severe

audio drift, even on the very short clips. After we had upgraded to the new version, we noticed that these problems disappeared. Version 1.2 provided solid synchronization during our 20-minute test clip.

The Python produced some of the best-quality videos in this review, with a combination of crispness and absence of background noise. It suffered from slight blurriness in low-light conditions, but it rebounded to produce excellent skin tones and facial contrast in our talking-head clip. The Python's only Achilles heel is its

lack of square-pixel support, which stretches all videos to approximately 110 percent of their normal appearance.

The Python supports square-pixel output for still-image capture, with four fixed capture resolutions up to 1,280-by-960, but it stores all images in compressed JPEG format. It handles motion reasonably well, but colors appear slightly faded and complex images show traces of JPEG artifacts. Still-frame performance is competent but inferior to the dedicated frame grabbers.

The Python is the ultimate product for VideoCD producers, who publish their wares on analog monitors that display in rectangular pixels. But if you publish on computers and don't want your boss or Aunt Sally to look 10 percent wider than they already are, you're better off with another product. **PC**

The Buzz on Iomega's Buz

For those willing to open up their PCs to install hardware, there's the Buz Multimedia Producer, Iomega Corp.'s SCSI-based entry to the video capture market. A \$200 (street) video solution that also captures still images, the Buz is an inexpensive, slot-saving solution for those requiring SCSI and video capture; its output quality was only average.

In essence, the Buz is an Ultra SCSI card with on-board Motion JPEG compression and audio capture and an external breakout box with S-Video and composite video and stereo audio inputs and outputs. You can install the Buz in any PCI 2.0-compliant slot, connecting to SCSI devices via one internal and one external connector. Bundled software includes MGI's VideoWave SE, Picture Works' Hot-Shots still image editor, and Iomega's RecordIt audio recording software.

After using a wizard that sets key capture and encoding

parameters, you capture video in MGI VideoWave. The Buz captures video in 15- and 24-bit RGB formats, with capture resolutions changing by format; there's no support for 320-by-240 square pixel capture. You can adjust the brightness, contrast, saturation, and hue of the incoming video.

We tested the Buz by capturing several clips, including a 5-minute torture test at maximum capture resolution and bandwidth. Though Ultra SCSI supports up to a 20-MBps transfer rate, the highest rate

enabled by the capture software was 3 MBps. Highly detailed frames showed blockiness and some fuzziness around the edges. These common M-JPEG artifacts manifested as increased background noise in the clips written back out to tape and compressed to MPEG-1 format. Also,



videos captured by the Buz were slightly faded.

VideoWave also captures still images in the same limited resolutions as video capture.

Though the software supports 15- and 24-bit RGB formats, images captured in these modes were entirely black; Iomega confirmed the problem and said a fix would be made available. The third alternative, M-JPEG, produced the same blockiness experienced in the captured video along with obvious venetian-blind artifacts, signifying deinterlacing problems.

The Buz is incompatible with PC systems that either lack PCI 2.0 compliance or have a graphics card without overlay support. Given the Buz's unique configuration requirements and lackluster performance, it's difficult to recommend it to any specific class of users.—**JO Buz Multimedia Producer**. Street price: \$200. Requires: 16MB RAM, 80MB disk space, Microsoft Windows 95. Iomega Corp., Roy, UT; 800-697-8833, 801-778-1000; www.iomega.com. Choose 412 at www.pcmag.com/infolink.

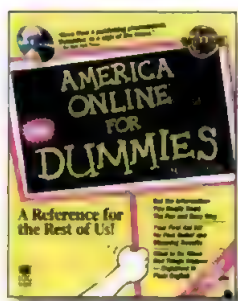


IOMEGA BUZ: Captured in M-JPEG format, the Buz's still image showed JPEG and interlacing artifacts.

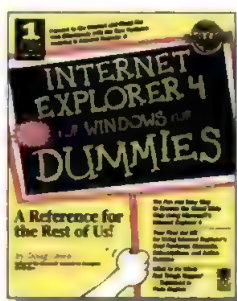
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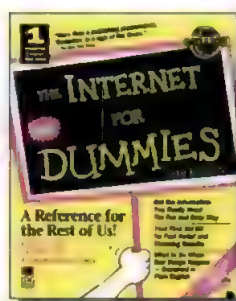




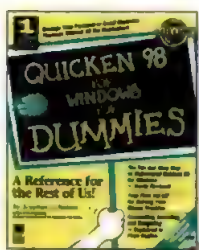
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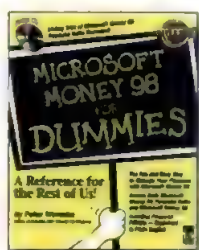
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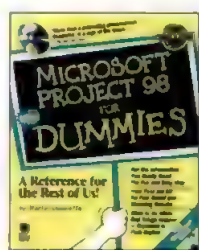
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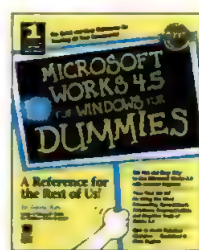
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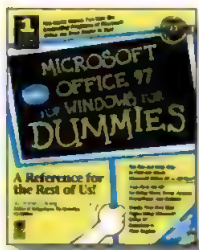
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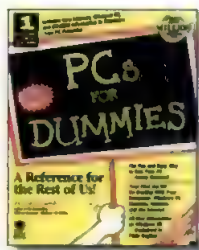
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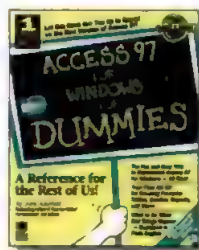
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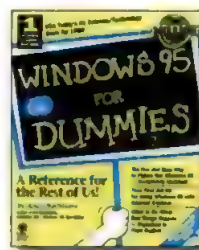
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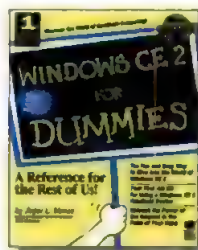
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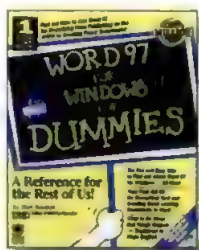
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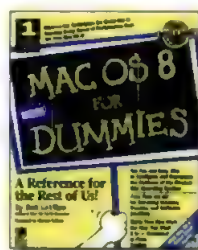
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First Looks

UTILITIES

Keeping Your PDA in Line

IntelliSync 2.0 adds new PIM and GroupWare converters, new data filters, and richer Outlook support.

By Bruce Brown

Puma Technology's IntelliSync product series has become the *de facto* standard for synchronizing personal digital assistant (PDA) and hand-held computing data with conventional PCs. IntelliSync for PalmPilot 2.0 (\$70 street), the latest version of 3Com's popular Pilot PDA, adds new connections to PIM programs as well as more powerful methods of working with contact, appointment, and task data.

In addition to its long list of previously supported PIMs, which includes Microsoft Outlook 97 and Schedule+, Day-Timer Organizer, Starfish Sidekick, and PalmPilot Desktop, IntelliSync for PalmPilot 2.0 adds Lotus Organizer 97 GS, Novell GroupWise 5.2, ON Technology Meeting Maker 5.0,

Oracle InterOffice 4.1, and Symantec ACT! 3.0.7.

The same basic conversion operations are available in additional versions of IntelliSync for Microsoft Windows CE devices, smart phones, and major PDAs from Sharp, HP, and Texas Instruments. Microsoft Outlook users will find that Puma's newest conduit for the PalmPilot supports Outlook subfolders, custom-designed forms, and user-defined fields. Testing was done using ACT! 3.0.7.

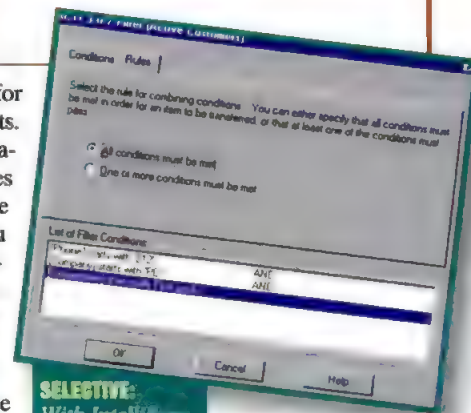
The core technology for all IntelliSync operations is Puma's patented DSX contact and scheduling synchronization engine. Puma's synchronization engine has the unique ability to work with multiple source applications, using one program for address content, a second for

tasks, and other sources for memos and appointments. After you choose applications and source data files from a simple interactive configuration screen, you initiate all synchronization with the PalmPilot via the HotSync button on the PDA.

IntelliSync's filtering tools let you determine single or multiple conditions and rules for selecting records based on field content from the address, schedule, and to-do list files. For example, you

could select contacts only in the 212 area code who work for *PC Magazine*. By combining the program's features, you could set rules to select all of your appointments, only high-priority tasks, and a select set of customer-contact information to synchronize on your PalmPilot.

If you're a 3Com Pilot, PalmPilot, or IBM WorkPad user, Puma's IntelliSync for PalmPilot 2.0 is a must, particu-



SELECTIVE:
With IntelliSync for PalmPilot 2.0, you can filter and conditions for data selection before synchronization.

larly if you use a variety of PIM programs. The new filtering features add more power and flexi-

bility to an already impressive productivity utility.

IntelliSync for PalmPilot 2.0. Street price: \$70. Requires: US Robotics Pilot, PalmPilot, or IBM WorkPad; docking cradle; 386 or higher PC; 8MB RAM; 5MB hard disk space; Microsoft Windows 95 or NT. Puma Technology, San Jose, CA; 800-774-7862, 408-321-7650; fax: 408-433-2212. www.pumatech.com. Choose 406 at www.pcmag.com/infolink.

WIRELESS MODEMS

PalmPilot Strolls the Net

Novatel's Minstrel Wireless IP Modem brings Web surfing and e-mail to 3Com's PalmPilot.

By Bruce Brown

The Minstrel Wireless IP Modem (\$400 street), from Novatel Wireless, connects PalmPilot and IBM WorkPad PDAs to the Cellular Digital Packet Data (CDPD) network (a.k.a. the wireless IP network). The 19.2-Kbps Minstrel modem adds bulk and weight to the PalmPilot, but in return it lets you send and receive Internet e-mail, browse the Web, and access information services from a growing list of providers.

The Minstrel worked well when we tested it in northern Connecticut and Manhattan and on a train ride into New York. It will be bundled with an e-mail program and Web browser,

though the specific titles had not been agreed upon at the time of our evaluation. The test model included SmartCode Software's HandWeb text-only HTML Web browser and HandStamp Pro POP3 e-mail client as well as Actual Software Corp.'s MultiMail e-mail client, which supports both POP3 and IMAP4 protocols.

The 8-ounce Minstrel acts as a cradle for the PalmPilot and increases its total size to 6.9 by 9.0 by 1.4 inches

(HWD) with the antenna retracted. A NiMH battery pack, an AC adapter, and a battery charger all come with the Minstrel 6. Battery

life is rated at 2.5 hours of continuous use and up to 8 hours in sleep mode (the unit we tested did not have the power conservation activated). A combination AC adapter and battery charger can plug into the modem to save bat-

ttery life and refresh the batteries in about 2 hours.

The Minstrel connects fairly quickly to the IP networks, but handshaking and data transfer take a bit of time. Viewing Web sites requires patience, and the lack of color



ADD-ON:
Novatel's Minstrel gets you online anywhere.

and graphics detracts from the Internet experience.

CDPD network providers currently deliver service in most metropolitan areas; this means the service is reachable by about 50 percent of the U.S. mainland population. Bell Atlantic offers unlimited connections for \$54.95 a month, while other carriers have different rates and rate structures, with expected monthly costs ranging from \$15 to \$60.

If you want to cut down on the electronic devices you carry, Novatel's Minstrel looks like a sure bet for PalmPilot users.

Wireless IP Minstrel Modem. Street price: \$400. Requires: PalmPilot Professional (or earlier version with 1MB upgrade) or IBM WorkPad, wireless IP network subscription. Novatel Wireless Inc., Phoenix, AZ; 888-888-9231, 619-784-0620; www.novatelwireless.com. Choose 407 at www.pcmag.com/infolink.

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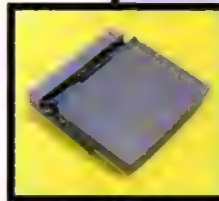


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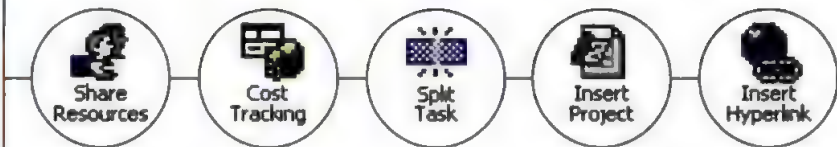
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Date: Wednesday, 4:45 p.m.

To: Planning Committee

Re: One more little thing...

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First Looks

INTERNET SERVER SUITES

The Web at Work

Netscape's SuiteSpot 3.5 offers better groupware functionality and Web links to e-mail and scheduling.

By Robert P. Lipschutz

Netscape Communications Corp. has gone from being the fastest-growing Internet company to the fastest changing. A slew of recent announcements has brought the company that championed the commercial use of the Internet into a turbulent adolescence. The one stable force has been Netscape SuiteSpot, the company's commercial Internet server suite. The latest version, Netscape SuiteSpot 3.5, provides better groupware capabilities, an enticing Web-document workspace environment, Web interfaces to e-mail and scheduling, and improved (if not perfect) centralized user administration. SuiteSpot 3.5 stands out like a lighthouse in a storm.

SuiteSpot is a well-integrated set of standards-based servers for the Web and groupware along with a full set of administration and security tools. You can purchase each of the SuiteSpot components separately, but Netscape has made the whole greater than the sum of its parts with centralized, browser-based administration and integrated user and group management.

STANDARD VS. PROFESSIONAL

SuiteSpot Standard edition handles Web, groupware, and directory functions, bringing together a collection of five Internet servers—Enterprise Server 3.5, Messaging Server 3.5, Collabra Server 3.5, Calendar Server 3.5, and Directory Server 3.0—and the LiveWire

Pro database connectivity development environment.

The Professional version gives you more administration and security servers along with

advanced information cataloging and searching. The Pro collection contains Compass Server 3.0, Certificate Server 1.03, Proxy Server 3.5, and the Mission Control Desktop, a set of administrator tools for centrally handling browser configuration options.

Each SuiteSpot Standard and Professional license includes a copy of the Communicator and Communicator Professional clients, respectively. This is more meaningful with Communicator Pro, since the Standard version is now free. One anomaly is that Calendar Server is part of SuiteSpot Standard, but the client is part of SuiteSpot Professional. All of the SuiteSpot servers run on Microsoft Windows NT, SunSoft Solaris, and a variety of other Unix platforms (AIX, HP-UX, Irix, and Digital Unix), so you won't need to wage religious battles over operating systems.

ONE DIRECTORY FOR ALL

One foundation of distributed applications is the directory service. Just as the Internet's Domain Name System handles the organization of servers across the Net, a directory server handles the management and organization of users and groups. Directories are important to administrators, because they facilitate centralized management of users. They're also important to users, because they provide a way to find out information (e-mail addresses or phone numbers, for example) about other employees or people outside the company.

Netscape Directory Server 3.0 handles all the user and group management for the SuiteSpot servers. Adding users and groups is easy enough via the

GUI interface, but setting access controls can be both complicated and confusing because of the clunky interface and the necessity of understanding LDAP syntax. We found that the interface sometimes gets corrupted if you move too many windows around. Communica-

But for major changes, you'll probably resort to importing an LDIF file, a tried-and-true task for those familiar with LDAP.

The replication model is simple, and most companies will opt to use a single master Directory Server, perhaps with feeds to secondary servers in different geographic regions. You can break up the directory tree onto different servers and then set up replication rules among them, but this can get complicated. Directory Server has simple referral capabilities that you can manually configure, so directory updates and reads can be directed to the correct server.

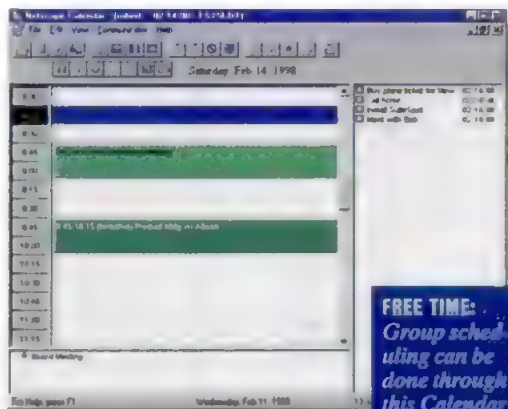
There are a few ways that users can search and display public content in the directory. The most effective way (using Netscape products) is the "search directory" option. Administrators can also set up a Web-to-directory gateway, so users can use a browser to access directory information, albeit through a more difficult interface. Also, any LDAP client (there are also a number of Unix applications and third-party tools) can view the contents of the directory.

PUBLISHING AND SHARING WEB CONTENT

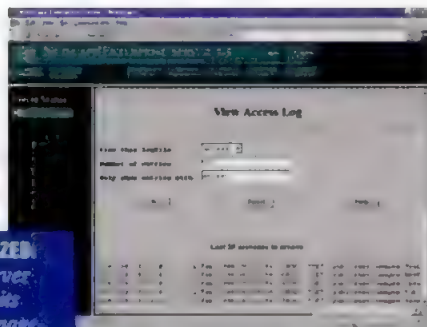
Enterprise Server has been enhanced to run faster on multiprocessor servers. The basic functions, including unlimited virtual servers and access control, remain the same.

Netscape has improved its Web-publishing interface in SuiteSpot 3.5 with a new set

of applications called Netshare, a virtual workspace for publishing, sharing, and viewing content. From a user's perspective, Netshare is just a URL that opens up many capabilities manifested as Java applets and HTML. Users can upload and

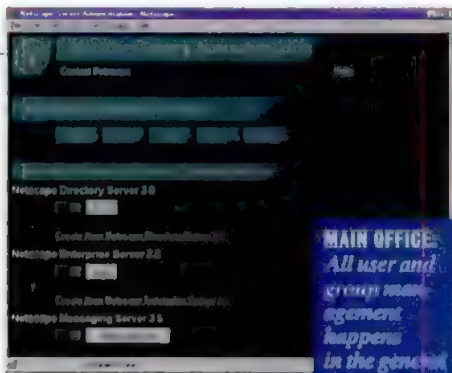


FREE TIME: Group scheduling can be done through this Calendar client or via Calendar Express.



CUSTOMIZED: Each server features its own management interface for server-specific configuration.

tor crashed on us a number of times when performing these tasks, perhaps indicating some too-advanced JavaScripts. You can extend the schema via the user interface to include items specific to your company.



MAIN OFFICE:
All user and group management happens in the general administration interface.

download documents and set access controls on their own spaces. It's a good way to share personal or project documents with others inside or outside your company.

Because Netscape must deal with the limitations of HTML and Java in building an interactive environment the interface takes some getting used to. A utility window that can't be minimized appears in your browser when using NetShare, causing some UI distraction. On the whole, we like how NetShare helps you migrate from traditional file servers to a Web-based document-sharing system.

You can also set up your own search engine using Compass Server. Compass Server can point to your internal Web servers (and even Internet Web sites), fetch all of the information from the sites, and then index the data. Users can search the indices or set up preferences and be sent an update of Web pages matching their content preferences.

GROUPWARE, INTERNET STYLE

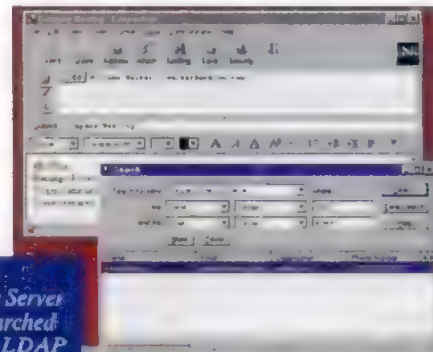
SuiteSpot offers three products that together make a formidable enterprise groupware solution: Messaging Server handles both POP3 and IMAP4rev1 e-mail clients; Collabra Server handles NNTP discussion groups, including Usenet or company-specific discussions; and Calendar Server provides group-scheduling capabilities.

Messaging and Collabra are

based on Internet standards: therefore, they can get accessed from any IMAP4 or NNTP client, respectively. Calendar Server uses Netscape's own protocol and requires the browser's Calendar client, currently available only in Communicator Pro. Messaging Server now comes with a Web-based messaging client called Message Express, which works with the browser and allows anyone to connect to a mailbox without tampering with mail-client preferences.

Internet mail has long suffered from the lack of a user directory. You either had to know your intended recipient's e-mail address or be lucky enough to have someone in your company enforce an e-mail naming convention. Since SuiteSpot keeps all e-mail addresses in Directory Server, you can simply do a search on this server from your directory.

For added security, you can connect from Communicator to the Messaging Server using SSL (Secured Socket Layer). Internet



FINDINGS:
Directory Server can be searched from any LDAP client, including the search utility in Netscape Communicator.

mail travels unencrypted from server to server, but at least you can protect the communication from client to server.

Collabra Server remains the same with its standard NNTP discussion groups. You can han-

dle both public and private discussions, a useful feature for building extranets. Like Messaging Server, the discussion-group client in Communicator can use SSL to talk securely with Collabra, so sensitive discussions can be conducted confidently.

Calendar Server and the associated Calendar client form a nice group-scheduling system. You can set up multiple servers for different regions or set up a central server. But there is an inconsistency in Netscape's Calendar product-line approach. Unfortunately, the Standard edition of Communicator does not currently have the Calendar client, so you'll be forced either to purchase Communicator Pro or use the less-functional Calendar Express.

Calendar Express works inside a browser and lets users read and create schedule entries, but it's a bit cumbersome to use day in, day out. The good news is that it provides an easy way for those not using Communicator to access the Calendar Server.

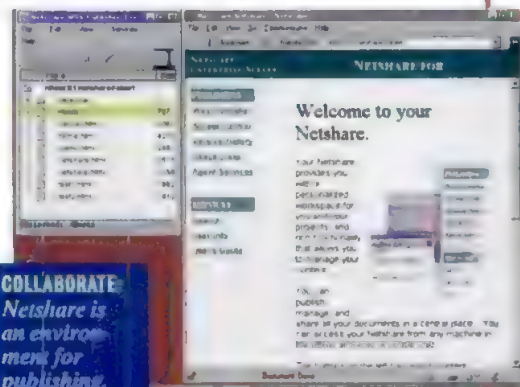
SECURITY

Some things have not changed with this new version of SuiteSpot. Proxy Server remains the same and provides a good solution for companies concerned about security. By putting Proxy in front of your firewall, you can better monitor and control outbound Web connections. In addition, user performance can increase for commonly accessed sites. This can be especially useful if your employees are accessing a partner site, since the Proxy Server will cache much of

this data over time.

If you're ready to explore the use of digital certificates as an authentication method, you can use Certificate Server as your own certificate authority. It has features for managing and revoking certificates and can be used for internal operations. For authentication to external systems, you're probably better off getting your certificates from a service like VeriSign, because the VeriSign CA is known and trusted by both Netscape and Microsoft browsers and servers.

SuiteSpot 3.5 is much better



COLLABORATE:
Netshare is an environment for publishing, sharing, and viewing Web content.

integrated with the central directory than prior versions were, but it still can be a little tricky. Netscape is continuing to improve the usability of its products, and Netshare and the new Calendar Servers are powerful steps forward. You'll still find bugs when using SuiteSpot applications, but the good news is that if you believe in the simplicity and interoperability of Internet standards, these are glitches you'll learn to live with.

Netscape SuiteSpot 3.5. List price: \$82 per user (Standard), \$140 per user (Professional). Requires: 64MB RAM, 500MB hard disk space, Microsoft Windows NT 3.51 or higher or Unix (Standard); 128MB RAM, 740MB hard disk space, Windows NT 4.0 or higher or Unix (Professional). Netscape Communications Corp., Mountain View, CA; 650-937-2555, fax: 650-528-4124; www.netscape.com. Choose 405 at www.pcmag.com/infolink.

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First Looks

LCD PROJECTORS

Lights, Camera, Project!

Toshiba's TLP-511A MediaStar XGA LCD Projector with attached document camera really pulls its weight.

By Alfred Poor

To keep pace with the higher resolution of current notebook displays, portable LCD projector manufacturers are now producing units with 1,024-by-768 XGA native resolutions. Toshiba has weighed in with an entry in its MediaStar product line, the TLP-511A (\$9,995 list price).

Although the TLP-511A MediaStar is fairly compact, at 17.6 pounds the unit is heavier than some new portable projectors. One reason for the extra weight is its unique document camera, which can be used to project images of papers or three-dimensional objects. As a result, you get a standard data and video projector that you can also use as

an overhead projector without transparencies.

The projector uses a three-panel polysilicon active-matrix LCD display design. A 2,000-hour metal halide lamp drives the projector to a rated 700 ANSI lumens. On our tests, we found that the factory settings resulted in a remarkably bright image, but the brightness level was set so high that light shades of gray were indistinguishable from white. With the image adjusted to levels that reproduced light and dark shades more accurately, we measured 407 lumens, which is still more than adequate for use in a room with normal lighting.

Our tests measured a fairly good contrast ratio of 59.5 and a good brightness uniformity ratio

of 1.3. There were noticeable vertical streaks down the center of the screen, but these did not detract from the image quality.

The image was very stable, even on some of our most difficult moiré patterns; if there was any jitter, the phase adjustment took care of it. There was some horizontal ghosting and streaking of high-contrast images, but the unit did well on the convergence and bandwidth tests.

The projector is easy to set up, and the on-screen menu system is intuitive. But the arrow keys and Enter button on the remote control serve different functions in different contexts, making it hard to navigate at times. Also, the pass-through connection for the computer monitor is on the projector,

which could be inconvenient.

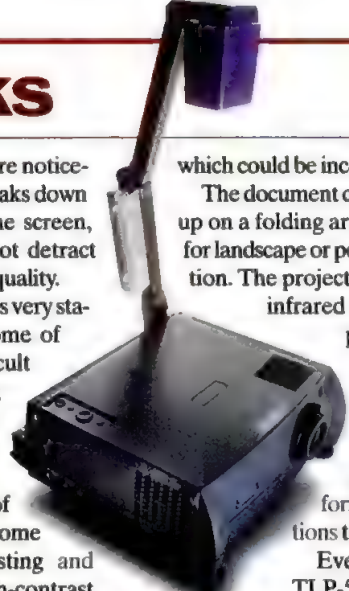
The document camera swivels up on a folding arm and rotates for landscape or portrait orientation. The projector also has an

infrared receiver that plugs into a PC's serial or mouse port, enabling the remote control to perform mouse functions too.

Even though the TLP-511A is a bit heavy to use as a traveling companion, its unobtrusive size, ease of use, and versatile document camera feature

should make it a local favorite.

TLP-511A MediaStar. List price: \$9,995. Toshiba America Consumer Products Inc., Wayne, NJ; 973-628-8000; www.toshiba.com/tacp. Choose 401 at www.pcmag.com/infolink.



MULTITASK:

The TLP-511A's camera turns the unit into an overhead projector.

INFORMATION MANAGERS

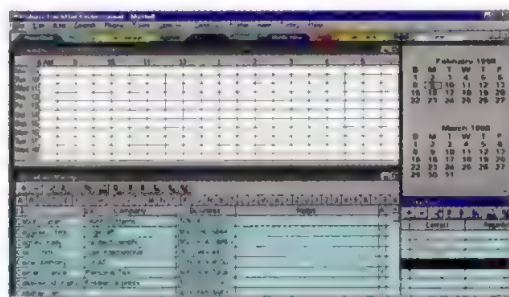
Keeping It Together

With Version 6.0 of PackRat Pro, Polaris Software brings its popular information manager back to life.

By Barry Simon

PackRat was once a major player in the PIM/contact manager arena. As one of the first products in this category to run under Microsoft Windows, it established itself as a somewhat eclectic but innovative product that its users loved. When PackRat 5.0 was released in 1993, it was ambitious but buggy and suffered from some unfortunate design decisions. Users howled, software reviewers panned it, and the company and product seemed to disappear from sight.

With the release of Version 6.0 (\$180 street), PackRat Pro has risen phoenix-like from the



PIMPLUS: Polaris Software's PackRat Pro organizes its tools into a collection of customizable tabs.

ashes. PackRat 6.0 has implemented the ambitious goals of Version 5.0, but with reliable performance and a more intelligent design. PackRat Pro also comes in a network version (\$700 for three users) that supports group scheduling.

As always, PackRat provides

many databases into which you can organize your data. Beyond the standard address book, phone log, calendar, and task list, there are index cards, a document tracker, and time, finance, and resource managers.

PackRat integrates with Microsoft Word 95 and 97 via macros. The contact list does a good job handling busy and nonresponding calls. (The program does not currently support CallerID.) You also can set multiple alarms for a calendar item, so you can remind yourself well in advance of (and just before) an important meeting.

PackRat was made for people who like to customize their environments. Although every list and view of that list is an object that floats on prebuilt tabs, you can create your own custom tabs with saved sorted views.

Though smooth, the interface could make more use of dropdown and right-click menus. Even in the default setup, there are more tabs than can be displayed on the screen, so you'll need to use the scroll bar to reach all of them. It would be much less awkward if there were a right-menu list presented when you clicked on a tab name.

Users who stuck with Version 4.107 (the last one before the Version 5.0 disaster) will find updating data a breeze. Users who updated to Version 5.0 will have a trickier import/export to cope with. Those who want a contact-centric PIM will need to take a serious look at PackRat. **PackRat Pro.** Street Price: \$300. Requires: 486/33-based PC or better, 4MB RAM, 8MB hard disk space, Microsoft Windows 95 or Windows NT 4.0. Polaris Software, Escondido, CA; 760-735-2300; www.polarissoftware.com. Choose 402 at www.pcmag.com/infolink.



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First Looks

WORKGROUP PRINTERS

Small Workgroup Wonder

Lexmark's latest small workgroup printer, the Optra S 1620n, is faster, easier to use, and better than before.

By James Karney

Less is definitely more when it comes to Lexmark's latest workgroup printer, the Optra S 1620n. The printer is less expensive, less of a hassle to set up, and more feature-rich than one would expect in a network-ready, 16-ppm, 1,200-dpi laser printer with a street price of \$1,300.

Rated at 65,000 pages per month and powered by an Intel 33-MHz i960JP processor, the Optra S 1620n comes standard with PostScript Level 2, PCL 6, a PCI-based 10/100Base-TX network interface, 4MB of RAM (expandable to 68MB), a toner cartridge, and a 250-sheet paper tray that handles up to legal-size media. Options include a duplexer (\$399 list price), an 85-sheet envelope feeder (\$349 list price), and additional 250-sheet, 500-sheet, and 2,000-sheet bins (\$279, \$349, and \$1,179 list prices, respectively).

SIMPLE SETUP

This machine has one of the easiest setups in the history of laser printing. We had the Optra out of the box and running on a Microsoft Windows NT network in less than 10 minutes. This was due in part to the novel way the unit was packed for shipping.

No longer do you have to play a game of hide and seek with a mass of brightly colored plastic restrainers. Gone, too, is the need to unpack and set up the toner cartridge and fuser assembly. All you have to do to get things started is lift

the printer out of the box, open the front, pull out the toner (which releases two clips), and slide it back in. Adding paper and hooking up the power cord and your choice of network and parallel cables completes the hardware portion of the installation.

MARKVISION

The software and driver setup is equally elegant, centered on MarkVision, which is Lexmark's remote-management software. First we used the printer's LED display and panel controls to set the network configuration and TCP/IP address. Then we loaded the software on the first PC, defined a virtual port to the IP address, and ran the Quick Setup utility

from the main window.

With MarkVision running, you are able to "see" the operator panel in a graphic display in real time and define any options settings. In addition, you can make use of the

software to establish service for almost any operating environment. For instance, we decided on sharing the printer in a mixed Windows NT Server, Windows 95, and Novell NetWare environment and linking it up with TCP/IP and IPX protocols.

PUT TO THE TEST

The Optra moved through our testing with the ease it showed during installation. Handling a random mix of protocols and printer languages proved no challenge at all. Print jobs printed properly in the same order they were sent, and we could watch their progress using MarkVision. The printer has an s-shaped printer path

with no noticeable banding, and large black areas are well-filled and even.

Line drawings from a CAD file produced clean diagonal lines without any disturbing jaggies. Prints of charts on transparencies displayed well, and the printer had no trouble with documents on card stock that was run through the regular printer path. Envelopes that we fed into the drop-down manual-feed tray in the front of the printer showed only minor crinkling around the edges.

There are small design touches that add to the pleasure of using the Optra S 1620n. In addition to lowering electric bills, the power-saver function makes the printer virtually silent (this is sure to be highly appreciated by people who work in small offices). The Optra's

front-loading toner cartridge is easy to install and remove, and Lexmark offers Optra users a discount on new, single-use cartridges as long as they promise to return the cartridges for proper disposal.

The Optra S 1620n is well-suited to its task, and it should please end users and administrators alike with its well-rounded features, speed, clean copy, and ease of use. The printer's competitive price also makes it a real value. Its only limitations for larger workgroups are its inability to handle larger-format paper stock and a bigger output bin.

Optra S 1620n. Street price: \$1,300. Lexmark International Inc., Lexington, KY; 800-539-6275; fax: 606-232-2380; www.lexmark.com. Choose 403 at www.pcmag.com/infolink.



NETWORK READY: The Lexmark Optra S 1620n is a breeze to set up. It features a print speed of just under 16 ppm for long documents with a mix of text and graphics.

leading from the tray on the bottom to the 250-sheet output bin on top.

It was difficult for us to get the printer to jam, and after we forced a jam with a crumpled page the Optra recovered and printed all the pages in the document. A timed test of a long document with a mix of text and some business graphics showed an average throughput of just under 19 ppm, and a single-page job hit the output tray in 15 seconds. Skin tones printed in photographic images were also pleasing.

PRINT QUALITY

Lexmark uses its own print engine and a new toner design in the Optra S Series. Text quality is good, with clean, sharp letters and solid blacks. Gradient fills at 1,200 dpi are smooth



PRINT HER: An output sample from the Optra S 1620n printer.

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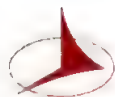
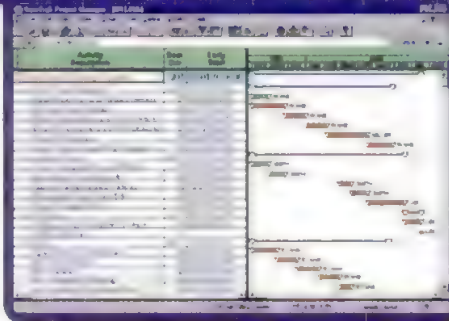
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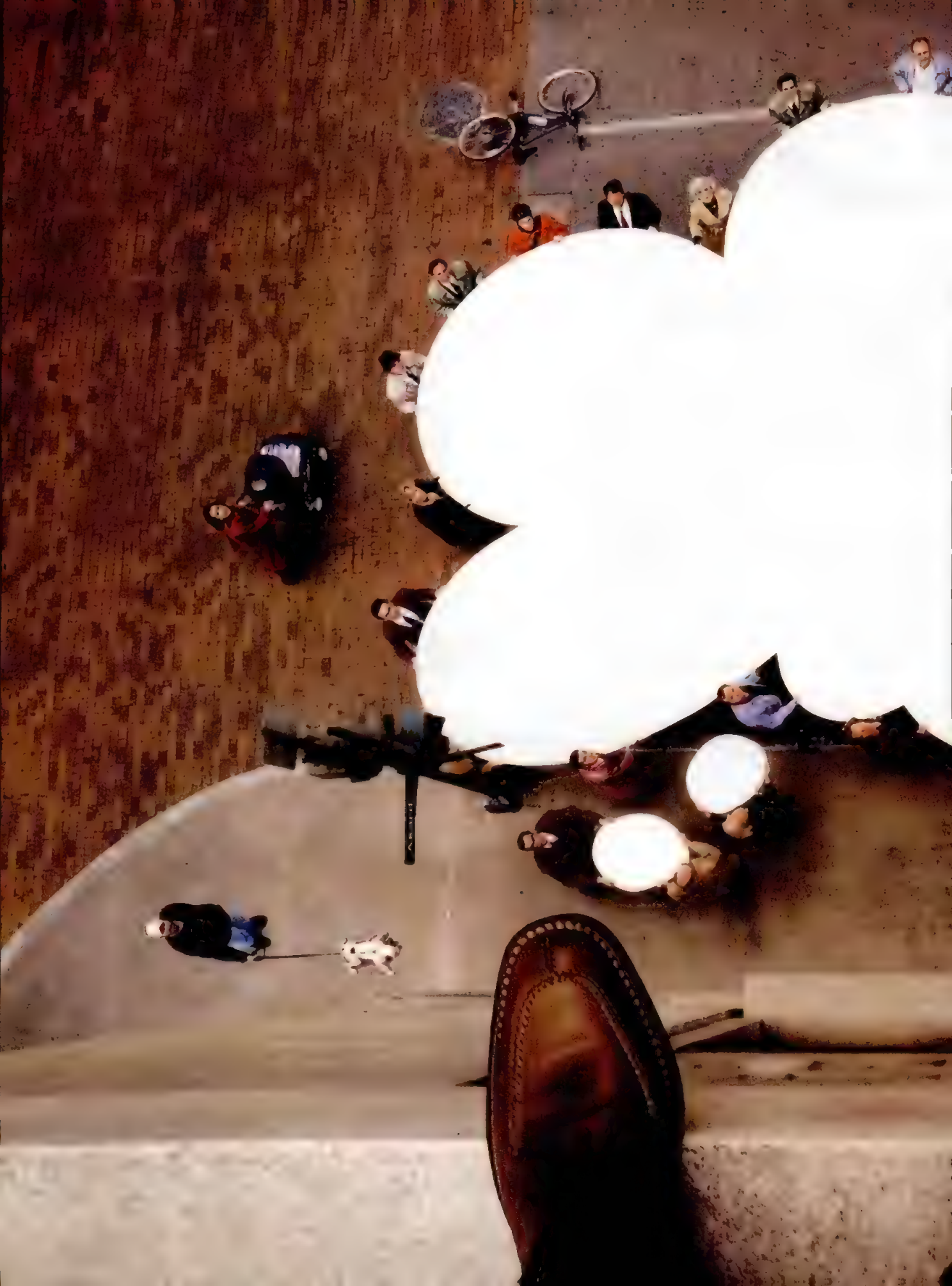


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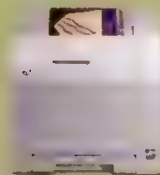
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First Looks

DEVELOPMENT TOOLS

Multimedia Is the Object

Using innovative object-oriented technology, Jasmine 1.1 lets programmers deliver multimedia over the Web.

By Richard V. Dragan

Computer Associates' Jasmine Developer Edition 1.1 (server licenses start at \$800) is a RAD development platform that offers an innovative object-oriented database and a fast front-end to Internet and intranet multimedia applications.

Jasmine Studio is the development tool for creating Jasmine applications. This RAD-based environment lets developers create object-oriented databases and front-ends to access their data. Jasmine's object-oriented database component is its most innovative feature. Developers can model real-world objects by using class inheritance. The class browser lets you design databases on the Jasmine back-end; these are then implemented in a proprietary database format.

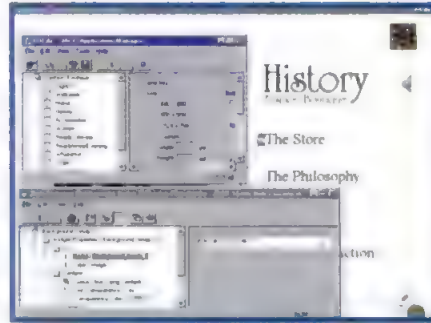
There are hooks to legacy databases too, including SQL servers and ODBC access.

Once a database is modeled, you build front-ends in the same development environment as Jasmine applications. There are over a dozen components available, ranging from standard text and edit controls to multimedia components. Each control can be bound to an existing database field, making it easy to combine static or animated images and sound within the same Web page.

With the designer tool, you place controls, set properties, and add events to coordinate with button or image clicks. The RAD-tool capabilities are adequate, but you will probably need some experience with similar programming tools. ActiveX components are also supported,

including those in Internet Explorer and ActiveX add-ons that work with multimedia content.

Object Database Query Language (ODQL)—the programming language behind Jasmine—is a proprietary, object-oriented scripting language that can build queries and perform calculations.



RAD: The Jasmine Developer tool allows you to combine multimedia components.

Even with the included tutorials and online help, it will take some work for most developers to get up to speed on this rich language, which has several dozen classes and is very strong in manipulating multimedia and databases.

A Jasmine application is easily deployed in HTML. For traditional client-server applications, you can also distribute standalone Jasmine applications. Since connectivity relies on sockets through TCP/IP or other network protocols, Jasmine delivers thin-client computing without the need to install database drivers on the client machine.

Consider Jasmine for Web sites or intranets that require heavy multimedia content with a minimum of developer overhead. **Jasmine Developer Edition 1.1.** List price: Free (server licenses start at \$800). Requires: Pentium PC

or better, 32MB RAM, 200MB disk space, Microsoft Windows NT 4.0. Computer Associates International Inc., Islandia, NY; 800-225-5224; www.cai.com. Choose 400 at www.pcmag.com/infolink.

PERIPHERALS

A Sub-Sub-\$1,000 PC

Create an additional Windows machine on the cheap by adding the Applica U2 to your PC.

By Daniel Grotta & Sally Wiener Grotta

Although PC prices have been dropping precipitously, the least expensive system out there will still cost you a minimum of \$800. Another option is to install the Applica U2 (\$250 street) onto your present Microsoft Windows 95 PC; add a monitor, keyboard, and mouse and voila: an instant tethered station. What's more, you can also create different users, each with his or her own password, configuration, and preferences. The downside is that the Applica U2's limited hardware may not be to your liking.

The Applica U2 consists of a proprietary ISA board, an exten-

sion cable, and an adapter for plugging in a VGA monitor, mouse, and keyboard. Installing



SECONDS: The Applica U2's proprietary ISA board.

the hardware is simple, although the adapter has only PS/2 mouse and keyboard ports. The standard 15-foot cable should be long enough to stretch between two

desks, but an optional 50-inch cable is also available for \$50.

Once the software is installed, you simply click on the program icon and up pops Applica U2's Control Center. Click the On button and the station will instantly display your primary Windows screen. Once the station is up and running, it looks and functions as an independent PC. We had no difficulty running any applications, loading or saving files, logging onto the network, or using a modem to surf the Net.

The primary PC and the station function independently, although they naturally can't work on the same files simultaneously. By using Windows 95's

User Profiles, you can customize the station environment for each user—individual user profiles and passwords, wallpaper, program preferences, and so forth.

Even though splitting computing power between two users theoretically slows everything down, we didn't experience any noticeable performance degradation on our Pentium/200 Sony Vaio with 64MB of RAM.

Unfortunately, the Applica U2 comes without sound support (meaning your games won't have sound effects). And although we could never pinpoint the problem or conflict, our test machine inexplicably locked up every so often and had to be rebooted.

The Applica U2 works as advertised, although by the time you add in the monitor, mouse, and keyboard costs, you're halfway to the price of a new PC. **Applica U2.** Street price: \$250. Requires: Pentium/100-based PC or better, 16MB RAM, Microsoft Windows 95, empty ISA slot. Concurrent Controls Inc., South San Francisco, CA, 800-487-2243; www.applica.com. Choose 415 at www.pcmag.com/infolink.



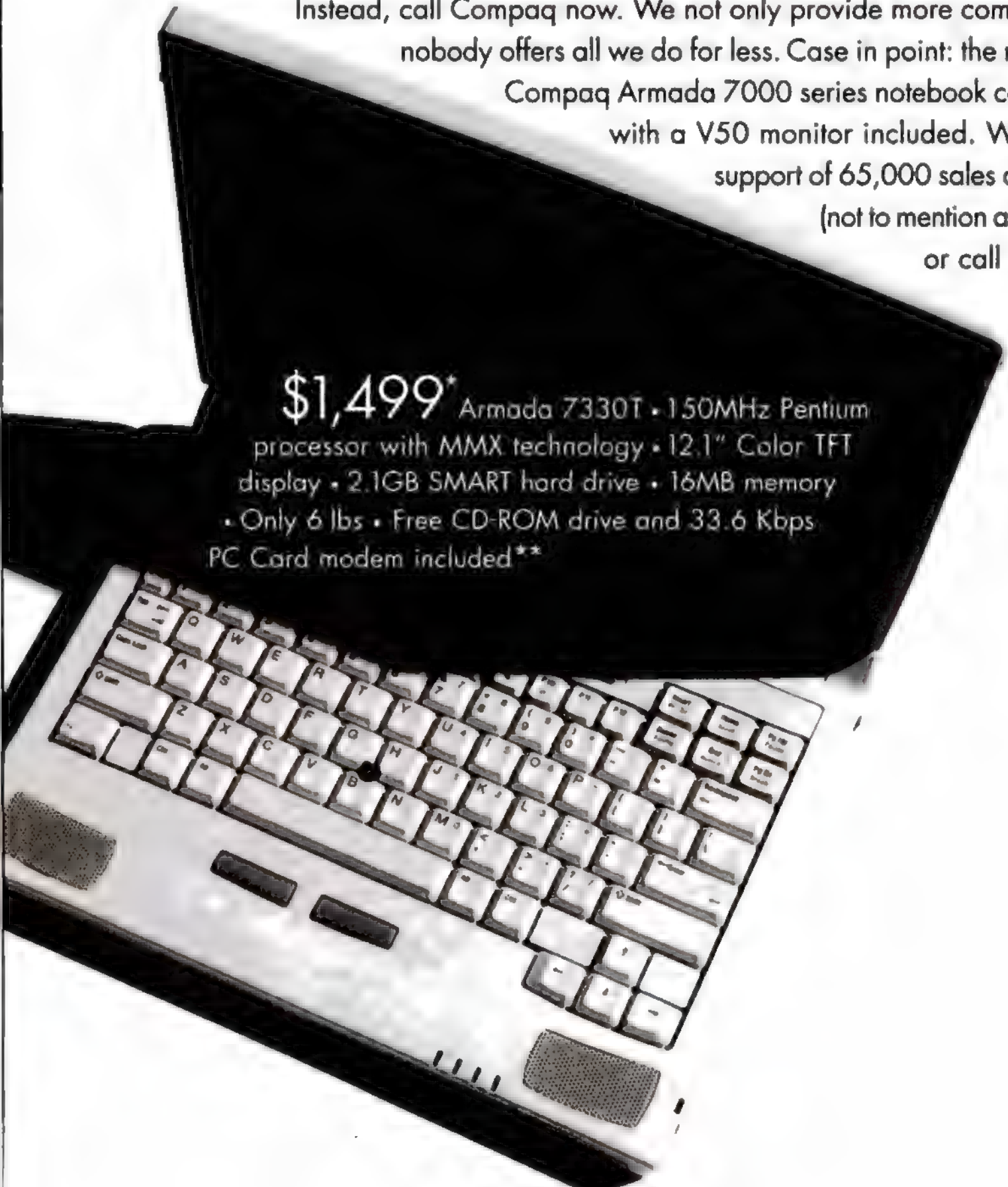
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COMPAQ

First Looks

FLATBED SCANNERS

Complementary Colors

LinoColor's ColorFactory Pro software makes its JADE² color flatbed scanner picture perfect.

By Daniel Grotta & Sally Wiener Grotta

Just as the sizzle is often what sells the steak, sometimes it's the software that sells the hardware. LinoColor's JADE² color flatbed scanner (\$499 list price) has the best software we've seen outside of professional prepress graphics scanners (which can cost more than \$10,000).

Based on the Umax Vista S-12 scanner engine, the JADE² is a true 30-bit device with 600-by-1,200 hardware resolution and an 8.5-by-14-inch scanbed. Bundled with the unit is a 32-bit Symbios Logic SCSI-2 PCI board, a 25-pin to 25-pin cable, and (a relative novelty) a 25-pin SCSI terminator, which helps give the JADE² moderately fast scan times.

COLORFACTORY PRO

The JADE²'s raw, uncorrected scans demonstrate good tone and sharpness as well as excellent dynamic range. But by using the various controls in ColorFactory Pro, you can get near-perfect scans with excellent color fidelity. You could make corrections in an image-editing program, but prescan corrections ensure a higher level of image quality. And LinoColor's color technology is far superior to what the average user can get out of a typical image-editing program. The base code and algorithms are so highly respected that Apple uses LinoColor technology for operating system-based color management (and in future versions of Windows, Microsoft will as well).

Working within the CIELAB

color model (which includes the widest gamut of viewable colors), ColorFactory Pro has encompassed the color space occupied by both RGB (monitor colors) and CMYK (used by printers). The software's native color space provides an ideal



environment for translating reflective or transparency color from the scanner to printed pages or for viewing on monitors and the Web. ColorFactory Pro also contains an ICC Color Profile manager, which fine-tunes scans for optimum color according to the intended output device. To ensure that your

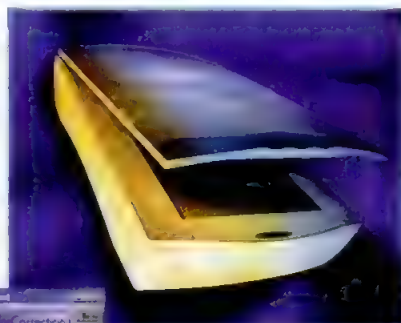
PIXEL PERFECT: With Finefield Correction, you can click on specific pixels in the image to change their color. The resulting color is shown in the color wheel.

scans are properly calibrated, the company includes a disk with an ICC profile for the specific scanner.

ColorFactory Pro can be as easy or as complex as you choose, ranging from automatic push-button operation to remarkably precise image tuning. All edits immediately update the preview image in the prescan window. The interface is filled with options that users can change or leave at their default settings.

COLOR CORRECTION

The software is most impressive and varied with color correction. On the most basic level, the Color Assistant dia-



HUE HELP: Once you click on the Color Assistant's side-pointing arrows, you are able to work directly on his tograms, gamma curves, and color wheels.

log has five icons

for picture types—skin tones, landscapes, jewelry, technical images, or sunset images—to help you make automatic corrections.

These corrections are based on both LinoColor's assumptions about image type and its analysis of the colors in the prescan. By default, it will work on five quali-

ADVANCED COLOR CORRECTION

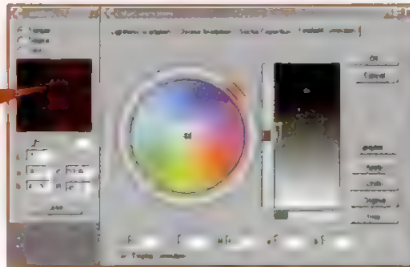
There is also a range of more complex correction tools at your disposal. For instance, to correct color cast, you can use

the Color Assistant by simply pushing a single point around a color wheel to change all the colors in the picture globally. For more advanced color correction, you can adjust Sector Correction and Finefield Correction. Using Sector Correction,

you can edit the hue, saturation, or lightness of specific colors in an image without affecting any of the other colors. For example, you can change a car's color from red to blue, or you can heighten the green of the grass or the blue of the sky. With Finefield Correction, you can click on specific pixels that you want to change in the prescan image.

Although ColorFactory Pro's tools can be incredibly precise and accurate, they are not difficult to use or understand. One minor annoyance is the fact that the toolbar can't be removed from the screen as long as the software is open.

ColorFactory Pro is so superior to any other scanner software that it makes it difficult for us to understand why anyone working in professional color would want to buy any other scanner in this price range. The JADE² scanner isn't bad, either. LinoColor JADE². List price: \$499. Requires:



ties: light, depth (shadow), color cast, contrast, and color (saturation). Any of the five can be turned off, allowing you more user control. Each of the qualities may also be automatically increased or decreased (at default single increments). You can also access the related histogram, gamma curve, or color wheel to further edit each one.

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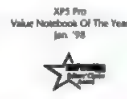
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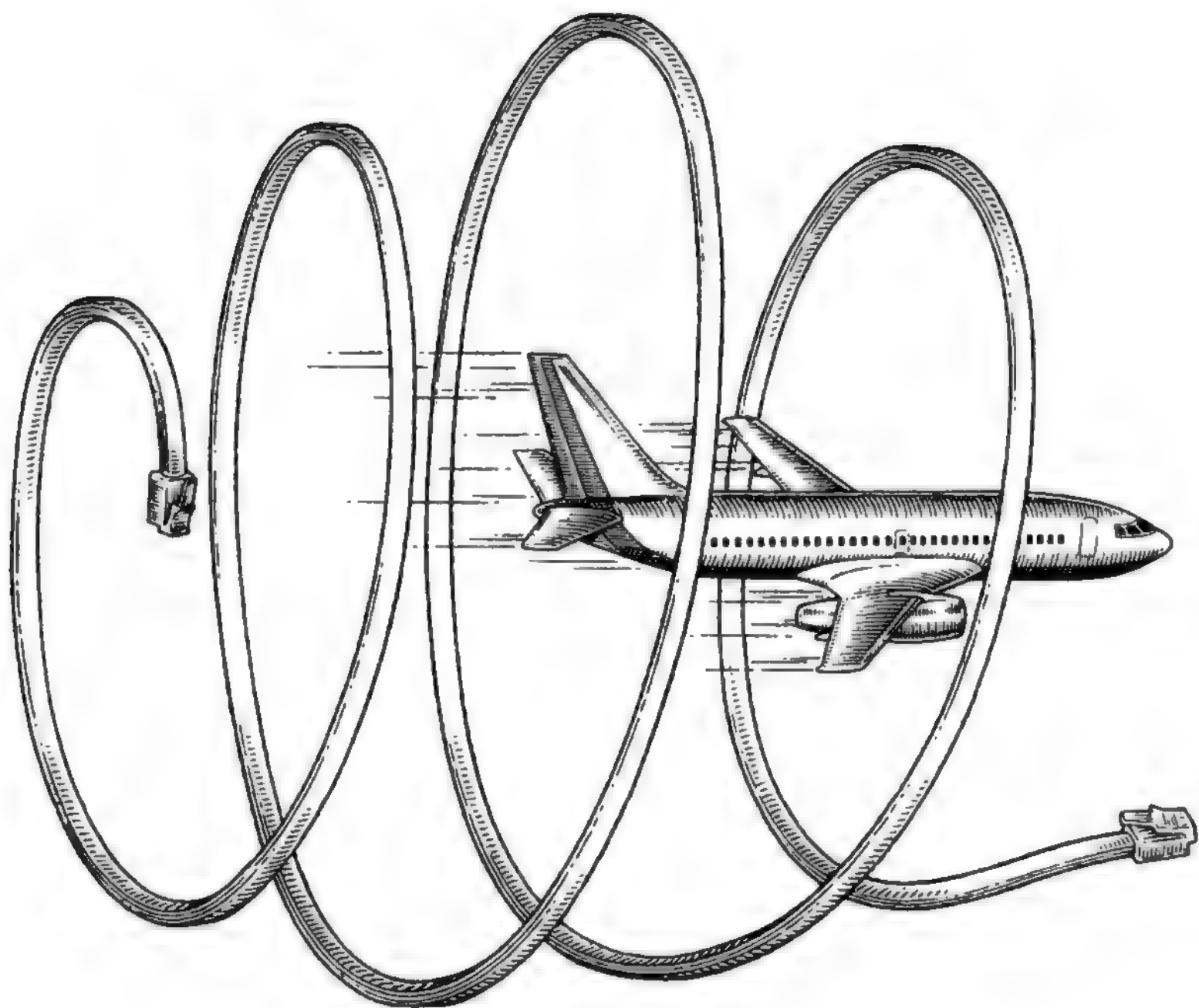


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Second Looks

OVM AND MARCO POLO TRAVEL

Tourist Attractions

By Jill Léger

In our story on travel Web sites ("Be Your Own Travel Agent," January 6, 1998), we lamented the lack of vacation services being offered. As a result, none of the 15 sites we reviewed earned an Editors' Choice for vacation travel. No site would let us buy a vacation package online, even in the rare instance when we could get a price quote. We also found insufficient integration between the reservations systems and resource information.

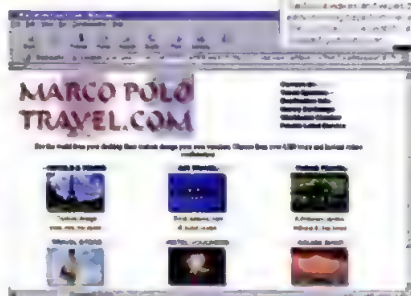
Two sites now let you arrange vacations online. Online Vacation Mall (www.onlinevacationmall.com) and Marco Polo Travel (www.marcopolotravel.com) are one-stop sites that let you arrange and pay for packages that can include everything from air travel and hotel accommodations to sightseeing excursions, museum passes, and theater tickets.

Online Vacation Mall (OVM) specializes in domestic travel, although you can find plenty of trips available to Mexico and the Caribbean. OVM also has vacation options for 18 European destinations, including London, Paris, and Zurich.

At OVM, you choose a destination and then enter an originating city, travel dates, and number of travelers (and, if applicable, the ages of up to four children). The service will then pull up ready-made packages developed by such companies as Southwest Airlines Vacations and Vacations by Sheraton. Most packages include air transportation, hotel accommodations, and optional extras like car rentals and day tours. If the

package you select is available for the dates you've specified, OVM will pull up detailed lists of options for flights, hotels, and tour packages.

When you have made your



choices, OVM gives you a price quote and asks for your credit card number. After filling out a travel form, you immediately receive a confirmation number and a guarantee that your travel documents are being sent to your billing address.

Using OVM isn't as intuitive as it could be, however. Most visitors will assume that the "destinations" option would be the first step toward accessing a list of packages, but clicking it and drilling down to a city pulls up only a list of area hotels and their ratings. To access package information, you must click on "reservations."

Marco Polo Travel is a slightly more exotic offering, specializing in international travel to spots such as Sri Lanka and Indonesia. Trips to 18 different countries are divided into such categories as accommodations and tours (which, in turn, are organized into theme categories, such as beach excursions, adventure tours, and archeological tours). Unlike OVM—which

connects you with ready-made packages—Marco Polo lets you have a free hand at customizing a trip to your own specifications.

After clicking on a country, you drill down to a city and then select from lists of hotels, tours, and other activities. With some destinations, you can arrange for car rentals as well as airport/hotel transportation. Each selection gets added in piecemeal fashion to your itinerary, which you can easily access and confirm at any time. As with OVM, packages can be ordered, purchased, and confirmed online.

One drawback to Marco Polo is that air travel is added sepa-

ately and must be purchased independently of other package elements. Because confirming your hotel and tour plans requires entering dates and (often) times, we recommend securing your flight plans beforehand. Doing so requires registering with Marco Polo's airline reservations area, where you can subsequently access flight and fare information and purchase tickets.

The only site we reviewed that has since added vacation travel is Expedia.com, from Microsoft. But it has done so by linking to four independent vacation sites in its Expedia Travel Network area: Ski Travel Online (www.skito.com), Cruise Outlet (209.61.18.60), Super Clubs (superclubs.com), and OVM for vacation packages.

ECCO PRO

Ecco of Discontinuity

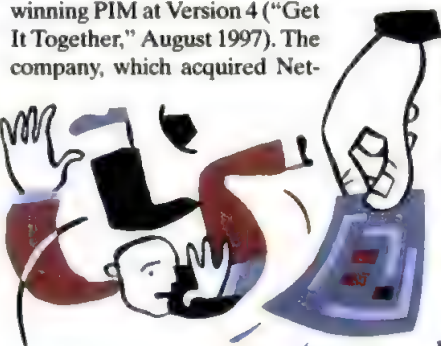
By Brett Krasnov

NetManage literally slid the rug out from under ECCO Pro users' feet when it decided to discontinue the development of its Editors' Choice-winning PIM at Version 4 ("Get It Together," August 1997). The company, which acquired Net-

during January and February to upgrade to Version 4, a time period that was actually extended from one month as a result of loyal users' outcries. NetManage (408-973-7171, www.netmanage.com) will continue to support those customers with active maintenance contracts, but it will not offer new or renewed contracts.

So where should current ECCO Pro users who missed the upgrade move their data? NetManage is not offering any ideas, since it is actively seeking to merge with another company or have another organization take ECCO Pro off its hands.

SECOND LOOKS MAILBOX: Tell Second Looks about your experiences with computer products. Contact Carol Venezia at cvenezia@zd.com.



Soft in July 1997, decided to focus on its flagship connectivity products—Unix Link, Host Link, and Chameleon—and abandon its development of messaging products.

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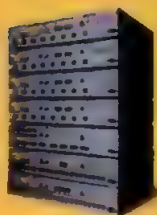


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High-Tech Philanthropy

The ultimate oxymoron? For years, the high-tech industry was regarded as a backwater of social unawareness and charitable inaction. The leaders of high-tech companies were all but invisible in positions of community leadership or philanthropy.

The personal computer business has been the foundation of some of the most notable fortunes of this century. Maybe Bill Gates won't have to lend money to the U.S. government, as J.P. Morgan did, but he's one of the wealthiest people in the world, and he's not alone. Young leaders in the computer industry have amassed fortunes rapidly as their companies have gone public, increased their market share, and achieved dominance. High tech has attracted the attention of the general public, but it has remained insular and inward-looking.

The absence of high tech from philanthropic activity is understandable from some points of view. First, the leaders tend to be young. Youth doesn't often think in terms of legacy. For every idealist who joined the Peace Corps, a hundred others tried to carve out a fiscal place in the world.

Culture is another factor. Many of the entrepreneurs who got hit by the money truck have come from working-class families, which tend to focus their charitable contributions on their churches or other local charities. Their first response when fortune smiles on them is often to build a magnificent house and populate the garage with Ferraris. Social issues and global concerns are pretty far down on the list.

A third factor is focus. I once chided Bill Ziff, the former owner of Ziff-Davis Publishing, for a gap in his otherwise encyclopedic knowledge of popular culture. He replied, "I was *working* during those years." Indeed he was, as he went on to amass a \$4 billion fortune. Entrepreneurs succeed because they're focused, and they let nothing distract them from their goals.

Volatility is an important fourth factor. Today's darling is tomorrow's dog, as investors stampede into new public offerings, then head for the hills at the first sign of distress. Many a newly minted millionaire has watched his paper fortune decline and even disappear.

Philanthropy seems more appropriate to one's middle years—when financial security is a given, when you've had all the children you're going to have, and when issues of legacy and social order become more important. Company

founders either get bought out or turn their companies over to professional managers. As the first wave of personal computer entrepreneurs have reached the proper level of success, stability, and social consciousness, they've begun to appear on the philanthropy radar.

Pacific Data Products was one of the early success stories of the business. John Downing achieved success by marketing font cartridges and memory enhancements for LaserJet printers. After he sold the company, he indulged his fascination with flying, but he also underwrote promising young athletes, setting up funds for their training.

Bill Ziff, through his support of the Rainforest Alliance, is ensuring a future supply of oxygen for all of us. Peter Norton achieved fabulous success with his books and utilities, then sold his company to Symantec. He and his wife Eileen now run the Norton Family Foundation, which gives grants for artistic and humanitarian purposes. Ted Turner is giving \$1 billion to the United Nations. Bill and Melinda Gates are giving \$200 million worth of computers to libraries.

Especially interesting is Social Venture Partners (www.svp.org), which uses a model familiar to high-tech entrepreneurs: venture capital. SVP "invests in long-term solutions to the social challenges facing our community." SVP is a good model for entrepreneurs who have achieved financial independence and are looking to share some of their expertise, funds, and time.

SVP currently focuses on children and education. Take a look at the grant guidelines and you'll see that their ideas could work in your community, too.

You don't need to be wealthy to get involved in philanthropic activities. Money is the engine that makes good things happen, but individual time and effort provide the traction that keeps them going. You can join an organization like SVP, but the real contribution is knowledge and time to work with people who have good ideas but may lack management experience.

Check with your local charities; they need you, and they need what you know. **PC**

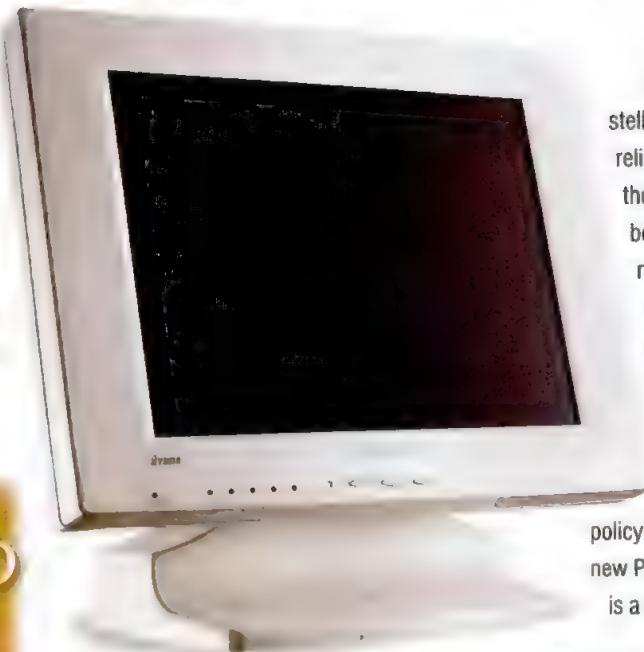


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The Real Merger: Compaq and Intel

The computer industry is heading toward the inevitable merger of Compaq and Intel. What leads me to this obvious conclusion is the fact that after a dubious lawsuit, the Alpha chip was transferred to Intel right before Compaq's recent buyout of Digital. I see all of

this as being triggered by the recent stagnation in innovation that has resulted from the (near) death of the Apple Mac. Hear me out on this one; it's a beaut.

Apple gave the PC business its last big boost with the introduction of the mouse and GUI. When Apple innovation stopped recently, we began to see an industry implode to regain true leadership. Over the ten years since the Mac was introduced, Microsoft engineers continued to take Apple's best ideas to produce a Mac "for the rest of us." And we have to thank them for all those good ideas, but underlying these ideas were hardware innovations: Windows wouldn't even work if it weren't for graphics accelerators. Microsoft is always accused of being a copycat, but, in its defense, it can't lead in new directions if those new directions have to be guided by hardware ideas. Microsoft makes hardware only when it has to. It developed the old EGA card to move people toward the GUI model, and it had to market a mouse to get people to use one.

The next step in the Mac age of computing was supposed to be integrated voice and video. There were designs to put a camera and microphone into the monitor cabinet. Only the microphone ever appeared, and only on some monitors; the camera never happened. Third-party companies marketed various cameras, but they have not become universal. Video will become standard in computing only when someone makes it a standard feature. This company can only be Compaq.

Compaq has reluctantly emerged as the industry leader, although the company's history has always been one of profound leadership. Its inaugural computer was the first portable IBM clone. It pioneered laptops. When the market was trying to make the transition from the Intel 286 during the PC AT era, the bets within Intel and elsewhere were on RISC; the 860 was a candidate. Without thinking twice, Compaq took the 386 chip and single-handedly moved the entire industry in that direction. It then, with others, promoted the EISA bus over the IBM Micro Channel, effectively killing the Micro Channel. More recently, Compaq

has blown the industry into a new direction by pioneering the sub-\$1,000 computer. The only serious flopperoo Compaq has had was its printer line. The fact is, Compaq is the leader—whether it likes the idea or not. But Compaq can't grow forever if there is only a single source for its parts. It

can't live long on a few Cyrix MediaGX chips and AMD's production glitches. AMD's recent stumble in producing enough K6 chips to meet demand was the final nail in this merger coffin. Compaq has to merge with Intel.

A Compaq/Intel merger would create one monster computer company that would really compete with IBM and the world. As part of the three-way merger, the Alpha chip had to be handed over to Intel because Compaq didn't want even momentary responsibility for the chip, knowing full well that the real merger—itsself with Intel—would still be coming. And if the Compaq/Intel merger falls through or has a bumpy road, at least Compaq knows it can get chips without running a fab. This also means that the Alpha is far from dead. Let's face it, both the Alpha handover and the Compaq/Digital merger were out of the blue and obviously part of a bigger scheme.

Intel needs to find a way to lock things up permanently. And the best way to guarantee that its chips will be used is to own the largest PC maker in the world. Furthermore, my arguments about video everywhere fit right into the Intel strategy. Intel has been an early booster and

would love to take its leadership to the next level, which it cannot do if it's always in the background. The merger would also put pressure on Microsoft to do the bidding of the mega-company, rather than the tail wagging the dog, as has been the case. Andy Grove, in particular, would like to see a kinder, gentler, more submissive Bill Gates. The new company would have the resources to create a new operating system, fine-tune it to a next-generation chip, and foist it on the public—cutting Bill out of the picture. Intel sees IBM as bumbling fools for not doing this already.

This is the obvious direction where things are headed. It's not a question of *if*, it's a question of *when*.



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Inside Track

The **chip wars** are not over despite Intel's large market share. Look for a comeback of the 68000 chip utilizing various redesigns and RISC cores. I'm amused that everyone talks about how RISC lost the war to CISC, but most every chip designed today has RISC in it somewhere. The early predictors who said that there would never be a **RISC/CISC battle** and that the two technologies would merge were right.

The most interesting development in the chip wars is Intel's new road map for the Alpha processor. The chip is being designed to run at a **gigahertz** within the next two years or so. Meanwhile, the third-generation Alpha (the 21264), now being sampled at 600 MHz, is expected to

double the proposed performance of the Intel Merced. This chip has been astonishing since its invention and has been appreciated only by those running high-end servers, where it outperforms everything on the market. **The Digital 8400 remains supreme** in this arena, with both sheer speed and a true nonstop architecture. It will be interesting to see how Compaq markets this gear. The possible irony of the Alpha's being made by Intel is that the **improvements** in the chip will **probably accelerate**, since Intel has a 0.18-micron process that is two years ahead of Digital's. Of course, if my theory about an **Compaq/Intel merger** is true (see my column in this issue), then there is no irony here, just a cool scheme.

The Bill Gates Pie-in-the-Face Dept.: As many of you know, Bill Gates got **hit with a cream pie** while schmoozing with some bigwigs in Belgium. There's a 52-year-old anarchist **goofball** named Noel Godin who has orchestrated numerous pie attacks on European celebrities and politicians. In one case a guy has been hit in five separate incidents. Apparently, the recipients of such attacks get **hit repeatedly** only if they do not exhibit a sense of humor regarding the attack. Gates should have accepted the pie in the face demanding "Next time banana creme!" or some such thing. Also, I suspect that Bill could manage to employ a few mercenaries to pie Noel Godin. But I'm not so sure it's wise to instigate a situation where a guy with that much money begins to try "dirty tricks." This pie incident, while amusing, was **ill advised**. Bill is hardly the first high-tech celebrity to be pied in the face. In an incident that was hushed up in the mid-1980s, Apple cofounder Steve Wozniak got hit with a pie.

While on the Subject of Microsoft Dept.: Look for the company to make a bigger and bigger push for Windows CE as it tries to move into hand-held phones and every other small device it can find. The company is also talking about doing a **real-time operating system**,

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according to an Alexander Wolfe report in *EE Times*. A real-time operating system actually works in real time, meaning that when you have to do something at 12:01, it gets done at 12:01. You can't have anything interrupting the process. Windows' **crazy** interrupt-driven quasi-multitasking architecture is a far cry from this. Real-time operating systems are needed, for example, to run nuclear power plants.

So the humor, as far as I'm concerned, emerges as soon as the **half-baked real-time OS** is described. I'm reminded of Windows 95's mediocre multitasking, compared with Windows NT or OS/2. In the case of a real-time OS, they are already saying things such as "real-time characteristics" and "consumer real-

time." In other words, not really real-time, but kind of. This is simply nonsense. Real-time is real time, plain and simple. Keep an eye out for this in the months ahead.

Genuinely Interesting Software Dept.: Years ago Visionary Networks (503-246-4043, www.iching.com) made a product called Synchronicity for the Macintosh, and the **touchie-feelie Mac users** loved it. The Oracle of Changes CD-ROM and Web site is the new version. Based on the I Ching, this \$49.95 program claims to **tap into the collective unknown** and generate answers to nagging questions. I've always found this sort of product amusing, if not a little wacky. It's particularly good at **picking stocks**, from my experience. Anyone familiar with the I Ching knows that its vague answers to specific questions tend to be interpreted to give the desired result. It's at least as good a decision maker as many "objective" programs and far more interesting than using a Magic 8-Ball. According to Visionary Networks, Paul Wenner (founder of the \$50 million company GardenBurger) made 300 serious decisions using this software.

Bandwidth, Bandwidth Everywhere, but Not a Drop to Drink Dept.: ADSL was the theme at the recent ComNet show in Washington. Many felt that the show was simply boring, but at least one new technology emerged. Its cute name—Hotwire MVL—should take it far in the press. It comes from joint development work done by Burr-Brown and Paradyne. Kind of a variation of ADSL, it offers a **symmetrical upstream/downstream 768-Kbps data flow** on plain copper phone wire. This stuff is **going nowhere**, because the phone companies know that any of these new technologies will result in people staying online all the time and making long-distance calls using IP. They want none of it without huge rate hikes. So don't expect any of this to be seriously deployed until cable modems almost take over the market and the phone companies react in a panic. **PC**

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1998: Year of the (Un)Wired House

It seems the computer industry has discovered the home. Your home, my home, all our PC-equipped homes. After more than two years of roaring sales of home PCs, the industry's seers and visionaries have looked around and decided that...ummm...well...we

have an awful lot of PCs in our homes! And where there are lots of PCs, there should be PC *networks*, right?

I don't want to seem cynical about the home networking business, because I agree that the notion of installing a local area network in your house or condo is about to explode. Moreover, I don't want to be a hypocrite here, because I've been enjoying the benefits of a succession of home LANs since 1986. Networks are Self-Evident Goods, in philosopher-speak, and if you have two or more PCs in your home (don't ask how many I have), it probably makes sense to network them.

Even if you don't mind playing sneakernet, copying files onto floppy disks to take to that *other* PC in your home that's connected to a printer, Internet access through a shared connection on a home network is so convenient that I'm convinced that here, too, the Internet is going to be the big driver in the home networking business. Not printer sharing, not file sharing, not security alarms, not turning on the coffee pot downstairs from your upstairs PC—as useful as all those can be.

It's fast, instant *anywhere* Internet access that will win you over.

So gurus across the nation are declaring 1998 the Year of the Wired (that is, *Networked*) Home. Half-right, half-wrong. As big a believer as I've become in home LANs, I'm convinced that we shouldn't be talking about wired homes but *unwired* homes. Because the big win in the home networking market is going to be in wireless LANs.

Anyone who has struggled to pull network wiring through the walls and floors and ceilings of an existing house will understand immediately when I say that's not just the old way, it's the dumb way. Sure, if you're building a new home or doing a really extensive remodeling job, it isn't too hard to run some unshielded twisted-pair to the spots where you may want to connect PCs, printers, or other digital devices. Not easy, not cheap, but possible.

(A quick tip, for those who are about to take that step: In my experience, no wire-pullers are half so good at snaking wires to impossible corners, without ugly surface wiring, as

commercial security-system installers. Ordinary electricians, phone installers, and network specialists are still used to working in office settings, where the ubiquitous ceiling tiles make all this a lot easier. And where, usually, aesthetics are a distant second to economy. If you want to pull wire, find a good security-system installer.)

Anyone who's worked on a wireless LAN in an office knows the power and convenience of wireless networking. I've been a big fan of such solid office wireless LAN products as the NCR WaveLAN and Proxim RangeLAN for years, and I use them myself. Being able to carry a notebook PC with me anywhere in my office, while always connected to the Net, is unbelievably convenient. Not cheap, but worth the cost.

What I've found with wireless networking in the home is that the benefits are even greater. Especially for notebook users—and I'm convinced that notebook PCs are the ultimate Mom and Dad home PCs.

Why pull all that wire, install the jacks, then tether yourself to RJ-45 jacks in wall plates? Wouldn't you prefer simply to carry your notebook wherever you want to go—to the breakfast table, the patio, the living room sofa, even your bed, where you can prop it up on your knees—rather than have to sit in a fixed place, or worse, string a network cable from your notebook to a wall jack that is never exactly nearby?

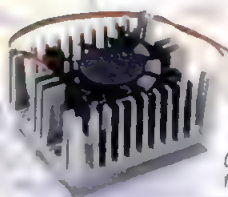
Moreover, wireless networking suits the way we live now. It's not ideal just for the owner of a Victorian castle, who probably couldn't get LAN wiring through the walls if she wanted to. It's great for people who live in apartments, where every hole in the wall means an argument at move-out. And even if you're not uneasy about punching holes in your apartment walls, why walk away from all that expensive wiring you've stuck in the walls when you move? These days 20 percent of the American families move every year. Do you really want to keep rewiring other people's residences?

Or would you rather simply plug in a wireless networking hub, stick wireless cards in your PCs, fire up the simple



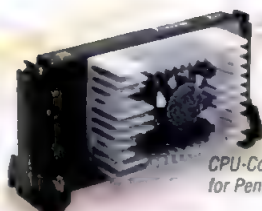
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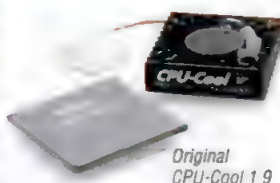
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JIM SEYMOUR

and generally underrated peer networking in Windows 95, and be done with it?

Sounds great, and it is. But it's also not cheap. At least, it hasn't been until this year.

In the past, setting up wireless networking meant a \$1,500 to \$2,000 wireless transceiver on your server or base PC, plus \$500 or more for the transceiver on each connected PC.

But that's changing, and fast. At this winter's Big Three computer-futurist conferences—David Coursey's Internet Showcase, Chris Shipley's Demo98, and Esther Dyson's venerable but still lively PC Forum—the halls and suites were full of companies talking about their hot new wireless networking products. The ones you want aren't available yet but will be later this year. Keep reading; I'm planning a comparison of the hottest systems.

At least conceptually, the best of these systems are pretty similar: Connect a cigar-box-size \$1,500 base unit to an AC line and a phone line someplace near where these lines enter your home. Buy a wireless transceiver (\$25 to \$50, they say), for each PC and printer you want to work on the system. Install some pretty simple software, flip the switch, and you're in business.

Note that these systems give you not only immediate peer-to-peer networking but also immediate shared Internet access, through as fast a connection as your phone company or cable TV provider can deliver.

Those prices make home wireless networking a no-brainer for a large percentage of America's multi-PC homes, which researchers say represent a rapidly growing trend: a desktop PC for Junior and Betty, Mom's notebook, Dad's notebook. The nuclear family online....

The usual caveats: I haven't put any of these systems through serious tests yet, and in general I've fooled with them just for a while. They seem to work well, but there's many a slip twixt the hotel suite and the real world. And while everyone talks about "\$20" wireless devices for connected PCs, it's hard to imagine even mass-produced PC Card devices coming in at that level. Double or triple that number and you'll be closer.

Which of these new systems is the best? Which will win? Beats me; it's way too early to make that call.

But I can tell you what will win big: wireless home networking in general. This time next year—maybe sooner—you're going to be reveling in the convenience of a cheap, fast home network, with semicheap, semifast Internet access. No wires included. **PC**

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The Perfect Laptop Bag

For years I've been hunting for the perfect laptop bag, looking at all types of bags in the process. Tastes change. In many urban areas the upscale backpack is now becoming accepted as something you can bring into a business meeting, and not just if you're under 30.

I've spent the past couple months poking and prodding at some two dozen shoulder bags, backpacks, and convertibles (shoulder and backpack). Here's my take on the best of the best. Among bags that sell for \$200 plus, you seldom find discounts of more than 10 percent. Except where noted, the prices for the bags below are list.

Best backpack; most ingenious bag overall. Hands down, it's the Tumi Deluxe Business Backpack (model 2640; ballistic nylon, \$325). The problem with most backpacks is that they're much taller than your notebook, and it's hard to find things that have fallen toward the bottom. Tumi's solution: Make the top 4 inches of the bag a zippered domed compartment that flips out of the way. Your notebook is encased in an elastic sling; there's a front pouch wide enough for file folders and a day planner, and enough internal, side, and zippered pockets to start a game of Where's Waldo? While it is a backpack, Tumi's 16- by 12.5- by 8-inch bag looks more like business luggage than like something you might wear on campus, and for an extra \$200 you can have it in leather. To me, the only drawback is that there's no shoulder strap for the times you want to wear it as a shoulder bag (www.tumi.com).

Handsome bags. Tie: the Coach Organizer Brief 532 (11 by 16.5 by 7.5 inches; leather, \$500) and the Hartmann ModemExcel Computer Organizer 512 (11.5 by 17 by 7 inches; ballistic nylon, \$300; leather, \$550). The flap-over Coach bag drew oohs and ahhs from *PC Magazine* staffers who already own Coach leather goods, although a couple commented that it's a bit shy on useful inside pockets. The nylon Hartmann is especially light and has lots of internal pockets; women on the road may find that it has enough useful but separate storage space to let them leave their purses at home (www.hartmann.com).

Ruggedest bag. The Tenba line. Lots of bags, no matter how cheap, carry limited lifetime warranties. If I were to place bets on which bags could take a licking and keep on ticking, it would those from Tenba, one of the best-known names in the photo-bag business. The Computer Back Pak

CBP-P (18 by 14 by 6 inches; \$200) is hard to overfill. (The smaller CBP-S, 16 by 12 by 7 inches, \$190, may be large enough.) And there's the C437 shoulder bag (12 by 17 by 6 inches; \$210). Tenba bags have plenty of thoughtful features; for example, many inner pockets are made of see-through

nylon mesh. You can convert the shoulder bag to a backpack by adding a \$30 harness that's sold separately. Ironically, the Tenba guarantee is limited to five years—but it's for everything short of deliberate destruction, and I'd take my chances with any of these bags (www.tenba.com).

Best "value." Among the bags that cost \$200 or more or look as if they do, the best deal is the Port Sport Classic (13 by 17 by 7 inches; canvas and leather, \$150; all leather, \$300). It's also somewhat jauntier-looking than your everyday black nylon bag (www.port.com).

Most expandable. Tumi and Tenba. Most Tenba shoulder bags and some Tumi bags, such as the Expandable Computer Brief 2622 (13 by 17.5 by 6.5 inches, \$295), have main compartments that expand by 2 or 3 inches when you undo a zipper that encircles the bag. These are great when you need to live within the airlines' two-carry-on limit.

Most protective bag. Three-way tie: Port, Tenba, Tumi. Port has done a lot of research, developing a U-shaped elastic sling and then an air-cushion system. The sling is being licensed to others, including Tumi. Most Tenba models have foam-covered corrugated plastic board inserts.

All should protect your laptop from virtually any fall.

These are the best laptop bags if you're feeling flush. But there are lots of models out there, so you should check catalogs, visit Web sites, or actually see the bags. Things to look for include the number and type of pockets and pouches, key rings, umbrella and pager loops, ready-access pockets for airline tickets and passports, and, of course, the look, feel, and construction quality. For those on more of a budget, next time I'll describe the best affordable bags. If you want more details on any of these bags, plus some that aren't described here, go to the Notebook User section of www.pcmag.com's Products Channel. **PC**



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BY JOHN GLYMAN

for

1998

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Does Java really matter? If you've been asking yourself this question, welcome to the club. Propelled by incessant streams of hype, the technology certainly has attracted far more attention than its few readily apparent successes would seem to warrant. Yet our look behind the hype clearly shows Java momentum is on the upswing—and in places that might not be apparent. In our review of Java from four different product angles—applications, environments, applet tools, and development packages—we find the answer to the question we pose above is: Yes.

To be sure, the list of hyped expectations is not short. Java seems unlikely to displace Microsoft Windows as the dominant desktop operating system, as some had predicted it might. And the technology has not taken over the world of embedded devices such as cellular phones. NCs—the much-vaunted network computers that are supposed to simplify PC operation and management while lowering costs—are almost nowhere to be found.

What about Java's boldest, most fundamental claim for programmers, that of "write once, run anywhere"? This phrase, so central to the Java message that Sun has trademarked it, embodies a beautifully simple idea: Programmers could develop software once that would run on any machine and on any operating system—without modification or additional testing. But as any experienced Java programmer will tell you, "write once, run anywhere" is just not real in today's world, with its

volatile virtual machines and dueling browsers, none of which implement Java in exactly the same fashion.

Even some of Java's earliest supporters, Web publishers eager to add interactivity to their sites, have backtracked. Their frustrations are twofold: Java programming can be resource-intensive (at least relative to HTML development), and the slow speed of most users' current

hype and make an informed decision about where Java fits in your organization.

In this four-part cover story, we evaluate the promises and the products. Java is important, but like any new technology, it is not a "silver bullet" that's going to solve every challenge your organization faces.

WHAT IS JAVA, REALLY?

To understand what Java can really do, it's important first to grasp what Java really is. On one level, Java is a programming language. But just as Windows is more than just a graphical user interface, Java is more than just another way to write code. Still, it makes sense to start there.

The Java language is superficially similar to the wildly popular C++, so C++ programmers generally find it easy to learn

Java's syntax. And as our story "Java Development Packages" reveals, Java development packages mirror the RAD

approach popularized with C++. But unlike C++, Java is object-oriented from the ground up. This helps programmers enforce good object-oriented practices, which leads to more maintainable code.

As with C++ and C, much of what is usually lumped together as Java—the-programming-language consists of runtime libraries. These libraries provide a standard set of facilities for manipulating the user interface, communicating across a

APPLICATIONS

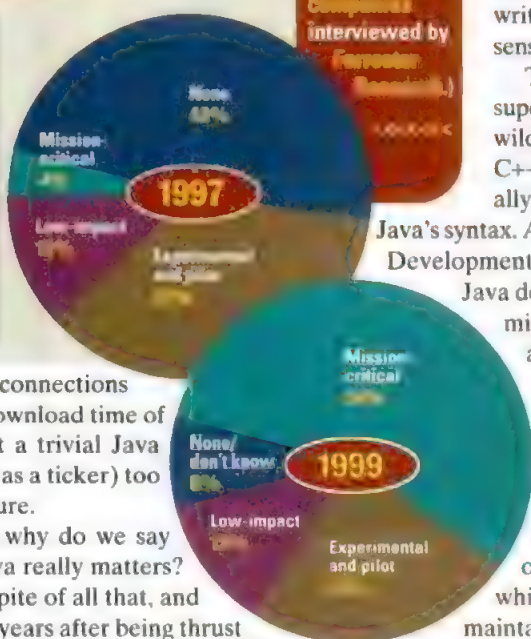
After a slow start, Java is finding its way into off-the-shelf applications. SunSoft lists more than 120 applications at its site as being "100% Pure Java."

PC Labs' Test Results

Our survey of Java applications demonstrates that Java is at last making some progress on the desktop. We discovered a wide range of applications, including productivity suites, financial tools, and e-mail clients.

Internet connections makes the download time of anything but a trivial Java applet (such as a ticker) too much to endure.

Okay, so why do we say that, yes, Java really matters? Because in spite of all that, and nearly three years after being thrust into the spotlight, Java is finally emerging in a tangible way. But rather than as a revolutionary technology, Java is emerging as a promising evolutionary one that will subtly but significantly change the course of computing. It's time to sort through the



Research alert...
What types of applications (will) use Java? (Source: 52 Fortune 1000 companies interviewed by Forrester Research.)

A Brief History Of Java

From household appliance networking tool to Internet darling and back, it's been a helluva seven years for Java.

January 1991
Java starts as "Oak," headed by James Gosling, intended to network household appliances.



March-August 1993
Sun refocuses Oak for a Time Warner interactive TV project. SGI wins the deal instead. Another deal falls through in August.

June 1994
FirstPerson (part of Sun) begins "LiveOak," again refocusing the technology for small OSs. A month later, the team retargets

Oak's potential for the Internet and points toward Java's current function

May 23, 1995
Java launches at SunWorld 1995. The first company to endorse Java: Netscape. Sun makes available an alpha version of its Hot Java browser



September 18, 1995

Public beta of Navigator 2.0, with support for Java applets, giving Java a major platform and presence on the Web.

October 1995

EarthWeb launches Gamelan, a Java resource directory and news site for developers.



October 24, 1995
Java discussed in PC Magazine for the first time "InternetWorking" column says Java is crucial for distributed computing, instant software upgrades, and making Web pages interactive, more seamless than browser add-ons.



network, and so forth. Consistency in the runtime libraries is important for achieving the "write once, run anywhere" claim and is in fact the focus of one Sun lawsuit against Microsoft. (The lawsuit alleges that Microsoft fails to provide two Java runtime libraries—RMI, for *remote method invocation*, and JNI, for *Java native interface*—and that Microsoft has engineered subtle but impermissible changes into the behavior of core Java libraries.)

Indeed, in late 1996, Sun launched its 100% Pure Java initiative, which examines each "Java product" against a tightly guarded certification process. Products that pass are labeled as 100% Pure Java and carry the guarantee that they use only standard Java features and should, theoretically, run on any properly implemented version of Java.

Sun currently lists more than 120 such products at its 100% Pure Web site. But there's one hitch: No widely used Java VM meets Sun's compatibility requirements. Netscape pulled the Java logo from its browser in late 1997, because its implementation was not fully compliant; Sun and Microsoft remain embroiled in legal battles over Microsoft Internet Explorer.

NOT JUST A LANGUAGE

If Java were just another programming language, the industry would have greeted its introduction with a resounding yawn. What makes Java intriguing is that it is also a runtime environment embodied in what is called a *virtual machine* (VM).

This VM sits, in essence, between the

Java program and the machine it is running on, offering the program an "abstract computer" that executes the Java code and guarantees certain behaviors regardless of the underlying hardware or software platform. Java compilers thus turn Java programs not into assembly language for a particular machine but into a platform-neutral "byte code" that the machine-specific VM interprets on the fly.

ENVIRONMENTS

*Java environments, also called **virtual machines**, are available for most operating systems. But Java applications **do not** behave the same across all OS platforms.*

PC Labs' Test Results

In our testing, Java Windows environments were by far the fastest performers and delivered the best overall compatibility. Still, no Java environment could run every application we tried, and no application ran across every environment on every OS.

Java application compatibility by operating system

Windows	70%
Solaris	53%
OS/2	33%
Macintosh	25%

The Java VM also enforces security policies, providing a sandbox that limits what the Java program can do. A Java applet cannot, for example, peek into arbitrary files on the machine it's running on. The most recent version of Java from Sun, known as Java Development Kit (JDK) 1.1, though, provides no consistent method for an applet to request restricted system resources. This capability will be available in JDK 1.2, due out later this year.

The lack of a consistent mechanism for

accessing local files is one major impediment to Java's success as a replacement for traditional productivity applications on the desktop.

The Java VM is not the industry's first attempt to develop a platform-independent computing environment. But Java has gained widespread attention where other attempts have failed, in large part because the VM was distributed

with browsers beginning with Navigator 2.0, thus giving Java unprecedented initial market penetration.

As our story "Java

Research alert:
What are the benefits of Java?

Cross-platform support	42%
Better for Internet/Intranet	16%
Increased productivity	12%
More robust applications	12%
No perceived benefits	10%

(Source: Forrester Research)

Environments" shows, however, the VMs on different platforms today simply don't behave similarly. This makes debugging a serious problem for Java deployment in a heterogeneous environment.

The compatibility situation is likely to get worse before it gets better: JDK 1.1 is a substantial change from JDK 1.0, which means that compatibility between the two is not assured. And the delivery of JDK 1.1 support in VMs has been surprisingly slow: JDK 1.1 is only partly implemented in Netscape Communicator and is largely implemented in Internet Explorer 4.0.

Moreover, even if all the VMs operated properly, "write once, run anywhere" is not necessarily a panacea. In fact, it places significant hurdles in the path of

December 4, 1995
IBM licenses Java, making a commitment to Java that will extend to hardware and software

December 7, 1995
Microsoft announces it will license Java. Microsoft's intent to optimize Java for



Windows sets the stage for a long simmering feud that boils over two years later

December 13, 1995
Symantec licenses Java and releases the first Java development environment for Windows 95 and NT, Symantec Café, an immediate success



December 19, 1995
Java wins PC Magazine's Technical Excellence

Award. Reason: It gives developers freedom, a streamlined language, and versatility

January 9, 1996
Sun forms JavaSoft to develop Java-based products and work with third-party developers.

January 23, 1996
Sun ships the Java 1.0 programming environ-

ment (JDK 1.0). Includes Java Applet Viewer, Java Compiler, and Java Virtual Machine for the first time

April 9, 1996
PC Magazine reviews JDK 1.0: It shows promise because of its cross-platform capability, but as a language and development environment, it is "as cafeteria

coffee is to Italian espresso."

May 29, 1996
More than 6,000 people attend the first JavaOne developers' conference. Corel announces its intent to develop the Java office suite, with Java versions



developers. For one thing, the Java VM generally presents applications using a given machine's native user-interface widgets (components such as command buttons and drop-down boxes). Thus, Java programs act in a fashion familiar to users on a given platform. But this also destroys user-interface consistency from platform to platform, which makes testing a serious problem. (The forthcoming JDK 1.2 contains support for "pluggable" user interfaces intended to alleviate this problem.)

In addition, "write once, run anywhere" implies a lowest common-denominator approach. To offer one often-cited example, not all computers (specifically Macs) offer a right mouse button. Should programmers have to forgo offering context-sensitive pop-up menus for every platform as a result?

Compared with native code, Java VMs are excruciatingly slow. The advent of just-in-time (JIT) compilers in Version 3.0 browsers, at least on the PC platform, helped alleviate this shortcoming. But for many applications, Java still cannot compete with natively compiled C++ code.

A key addition to JDK 1.1 is support for JavaBeans, a component model for Java. JavaBeans make it easy to write reusable components that can be strung together with a minimum of additional coding. Although Microsoft's ActiveX offers similar advantages, Beans are less focused on a Windows-centric world and are somewhat more portable. Still, ActiveX does have the advantage of supporting any underlying programming language, while Beans are designed solely to encapsulate Java.

JAVA AS A NEW PLATFORM

Java and the Java VM together provide a set of services that Java programs can rely on, regardless of the underlying hardware and OS. In this respect, Java has become positioned as a new platform—a target environment for applications.

Why does the world need a new platform when Windows is clearly the PC platform of choice? For one thing,

APPLET TOOLS

Java still has much to prove on the desktop, but anyone can easily create Java applets that add interactivity to Web pages.

PC Labs' Test Results

As Java authoring tools mature, they become specialized. On our tests, BeanMachine ranked excellent on ease of use; it is suitable for creating a range of applets. Jamba excelled at creating multimedia applets and is geared toward professional Web designers.

The sites include these Java resources:

244 business and finance, 329 arts and entertainment, and 1,515 games.

A resource is generally defined as a place in a Web site containing Java applets, examples, or information.

(Source: Gamelan: The Java Directory.)

to software compatibility. This is also why Java will never replace Windows as a general-purpose desktop OS: There's simply too much existing investment and inertia in the Windows platform and too little to be gained by rewriting all that software.

Indeed, as our story on Java applications illustrates, today's Java applications generally don't provide compelling alternatives to existing, highly refined Windows

software. For example, Corel's early attempt to take its Windows applications and simply make them Java applets (Corel Office for Java) didn't work, because Windows applications don't just

simply translate into some lighter versions of themselves. Java developers are finding that Java applications work better when they are put together as bits and pieces, as in Lotus's eSuite.

WHERE JAVA MAKES SENSE

In the business world, Java makes some sense for deployment in extranets. Java's cross-platform promise means that theoretically you can create applications to use with your customers and suppliers and not have to worry about not having control over the environments they're running. The fact that Java applets are downloaded on the fly eliminates the explicit software installation process and extends their reach. But hurdles are high here, both because HTML can offer an even better cross-platform story than Java (though it's not interactive in the same way) and because cross-platform testing and debugging remain so difficult.

of WordPerfect and Quattro Pro. The plan ultimately fails.

June 11, 1996

PC Magazine takes its first significant measure of Java and Java Tools in PC Tech section. Conclusion: Developers are right to be excited about the potential, but the language and tools are still very primitive.

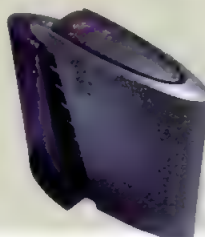
October 22, 1996

PC Magazine speed trials on Java environments: Microsoft Internet Explorer 3.0 has the best Java performance by far. Navigator 3.0 is significantly faster than 2.0 because of the new just-in-time compiler.

October 29, 1996

The Java Enterprise Computing launch includes the announcement of

JavaStation network computers. Sun extensively demos the Java station but doesn't ship it.



December 11, 1996

At Internet World, Sun announces the 100% Pure Java initiative, endorsed by more than 100 companies, with one notable absence: Microsoft.

February 18, 1997

JDK 1.1 released. A dramatically improved lan-

guage, including JavaBeans, print, and database access.

March 17, 1997

Sun applies to the ISO/IEC Joint Technical Committee 1 to become a recognized Publicly Available Specification (PAS) submitter for Java.

April 2, 1997

The second JavaOne has

more than 10,000 attendees. Sun releases JavaStudio, a visual component builder for JavaBeans. Announces Enterprise JavaBeans—further potential for Java in business—and PersonalJava, a version for consumer appliances, bringing Java back to its roots.



Another compelling use for Java may be in the middle tier of transaction-processing systems—not the servers or the clients but the “business logic” in the middle that actually describes the processes of filling an order or tracking a request. Java’s platform neutrality means, theoretically, that you can write code once and have it run on any Java-enabled system. Although you may not need to run the applets simultaneously on different platforms, having the flexibility to move from, say, a Windows NT to a Unix server without rewriting code could be beneficial.

It also would be unwise to ignore Java’s prowess as simply a good back-end development environment. JavaBeans offer a promising mechanism for building general-purpose business components that you can reuse with minimal modifications. And Java’s simplicity (relative to C++) may improve programmers’ productivity. In any case, whatever Java’s pros and cons, there’s no disputing that many programmers simply enjoy using it.

Another place Java may make sense is in highly vertical, single-purpose applications that are essentially custom-developed front ends to transaction-processing systems, often as replacements for traditional “dumb” terminal applications. This is the one area where NCs stand a real chance of succeeding in a big way. IBM, in fact, has made some sales into precisely this sort of market.

In these environments, a general-purpose PC may be unnecessary or even counterproductive. And it’s worth noting here that the idea of NCs for the home is a nonstarter: Low PC prices negate any

cost advantage, and network connections simply aren’t fast enough to rely on remote storage.

What about embedded devices? Java has some high hurdles to clear here, as embedded devices are often limited in purpose and constrained in power and size. That tends to argue for dedicated hardware, especially given that platform-independence in this area is less crucial.

DEVELOPMENT PACKAGES

Nearly all Java development packages offer the preferred RAD approach. Several provide tools for server-side Java development.

PC Labs’ Test Results

In evaluating the products, we looked for the best combination of power and ease of use. We found that each package in our roundup delivers sufficient support for most development tasks, but they vary in their flexibility, extensibility, and number of visual creation tools. Here’s how they line up.

- Sybase PowerJ Enterprise Version 2.1
- JBuilder Client/Server Suite
- Visual Café for Java 2.1
- VisualAge for Java
- Sun Java WorkShop 2.0
- CodeWarrior Professional

But TCI has signed a deal to use Java in some of its television set-top boxes, and Nokia has signed a similar deal to use Java in cellular phones, so we may yet see progress in this area.

WHAT IT ALL MEANS

At this point, it’s clear that Java technology holds promise—but also that Java has been overhyped and needs a reality check. Sun could help assure Java’s success by focusing less on its potential to dethrone Microsoft

and more on its use to solve real-world business problems.

Furthermore, Sun needs to make the Java Compatibility Kit public and allow third-party verification of compatibility claims. Such a public test would help catalyze more compliant VMs. And Sun needs to reassure developers investing in Java that future releases of the JDK will maintain backward compatibility with existing code. Ignoring backward compatibility has been a deal killer in the past. (According to Sun documentation, there’s no guarantee that a JDK 2.0, for example, would support JDK 1.x programs.)

If you’re in position to decide what to do about Java now, our advice is definitely to begin experimenting with it on a limited

basis, particularly on the server side. You should document idiosyncrasies and develop a “safe list” of techniques that work reliably on all the platforms you need to support.

Adhere to rigid object-oriented programming practices and design your objects’ interfaces carefully, with a clear focus on reusability. Then if (or when) Java turns out to be the right solution for larger projects, you will have a solid foundation to build on.

In the pages that follow you’ll find comprehensive evaluations of Java products to help you determine exactly where you should dive in and ride the Java wave. **PC**

**Report
Some 50,000
programmers
are using purchased Java
programming
tools on a regular basis—roughly double the 1996 figure. 12,000—or 25% of them—call themselves “Java corp.” (Source: IDC Research)**

May 27, 1997

PC Magazine’s first cover story on Java: Java environments and first-generation applications. Conclusion: The excitement



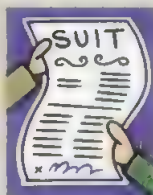
ment of using Java office applications can not overcome limited functionality and notorious instability

August 27, 1997

Sun CEO Scott McNealy interview in *The Wall Street Journal*. “By any comparison—fire, electricity, the wheel—the rollout [of Java] has happened at an unparalleled speed.”

October 7, 1997

Sun announces lawsuit against Microsoft for breach of its Java license,



citing the failure of Microsoft products such as IE 4.0 to pass Java compatibility tests.

November 3, 1997

Lotus announces eSuite Workplace (begun in January as Kona), a set of Java-based, platform-independent desktop productivity applets. The applets are designed for IBM’s NC—the Network Station 1000

December 16, 1997

Java is the big winner in PC Magazine’s Technical Excellence Awards. JavaBeans and Visual Café for Java 2.0. James Gosling and the Java Team win the Persons of the Year award.

January 1998

Tele-Communications Inc (TCI), the nation’s largest cable provider, selects PersonalJava as one operating system for its digital set-top boxes, bringing Java full circle to interactive TV. But TCI also licenses Windows CE for the same purpose. Stay tuned.

"HOUSTON, YOU HAVE A PROBLEM."



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While Compaq's 8-way server languishes in a six-month countdown, HP's LXr Pro 8 has already left the pad. Optimized for the NT operating system, the HP LXr Pro 8 is the first server from a top-tier vendor to deliver the 8-way Intel® Pentium® Pro processor, and the only server to deliver the next generation of I/O throughput with I2O disk array technology. It's one small step for HP, one giant leap for IT. Visit us at www.hpresource.com/lxrpro8 or call 1-800-533-1333.

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APPLICATIONS

BY PETER COFFEE

Although Java has received much attention, until recently it has been slow to find its way into mainstream applications.

Our survey covers more than 20 Java applications in a wide variety of categories including office suites and utilities.

IN THIS REVIEW	
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Since its inception three years ago, Java and its promise of platform-independent computing has captured the attention of developers. But the lack of off-the-shelf applications has prevented Java from attaining mainstream success. That's finally beginning to change.

Software vendors are turning to Java not only as a language for making Web pages more interactive or building enterprise applications, but also as a platform for creating everyday end-user software. In this section, we survey more than 20 of these new products. Our coverage is divided into four categories: productivity applications, financial applications, Internet applications, and utilities.

Although Java applications have come a long way since we last looked at them ("Java: A Field Guide for Users," May 27, 1997), in few cases would you mistake these programs for Microsoft Windows applications. On our tests, we found many were difficult to install and set up, and they still can't match their Windows counterparts in terms of performance or features. Nevertheless, Java applications do offer significant advantages—platform independence, portability, and the potential for lower cost of ownership—that will make them compelling to many businesses and end users. When you compare these applications with those available a year ago, it's clear that Java is headed in the right direction.

www.pcmag.com/features/java98/

Our interactive version See more demonstrations of Java technology online at PC Magazine's Web site. You'll find narrated walk-throughs of products, interactive features tables, and a place where you can tell us what you think about the reviewed products.

WHY JAVA?

In a perfect world, programming languages wouldn't matter to end users. After all, how often do we stop to think about what language was used to create our office suite? In the real world, however, programming languages do matter—they have a profound effect on feature sets, performance, and the costs of hardware and administration.

Java offers a solution to this problem by isolating applications from both hardware and operating systems. Unlike Windows programs, which are almost always compiled for that platform using tools that preclude their running on anything else, Java applications can be designed to run on any system that has a Java Virtual Machine (VM), also known as a Java Runtime Engine. The VM takes Java byte code and transforms it on the fly into instructions that can be executed by the PC. The same byte code can be interpreted as hardware-level instructions for any other platform with a VM implementation.

Java can be used to create two types of programs: applications and applets. Java applications, like those written in other languages, are standalone programs. They require a VM to run, but this runtime environment may be separate, embedded in the OS or in the application itself. By contrast, applets rely on a Web browser with a VM (such as Microsoft Internet Explorer or Netscape Communicator). Since applets are designed to be downloaded, they are also much smaller than applications.

In addition to platform independence, Java applications offer several other advantages. First, Java was designed for network computing and makes hiding the differences between local and remote resources easy. This makes Java an ideal tool for so-called thin-client computing, in which most of the processing and storage is handled by a server, while the client is used largely for display and interaction. Proponents of Java claim that thin clients, also known as network computers (NCs), will reduce the cost of purchasing and maintaining computers.

Second, the Java programming language has a rigorous object-oriented model that makes it possible to build mod-

ular applications. An end user need only download a particular feature of a Java word processor when needed, for example.

This dynamic design also lets companies create custom desktop environments that display only those applications required by each end user.

Our survey is devoted largely to applications. But some, such as Netmosphere's ActionPlan, also work in conjunction with applets—in this case, to distribute project information among team members. In some cases, we've included an applet or Java-Bean (a reusable Java component) that provides the functionality of an application.

The results of our testing were mixed. In general, we found that installation and setup of Java applications can be frustrating. Many programs required extra legwork: manually copying files to specified directories, editing initialization files, and so on. Once we got the applications up and running, however, they generally worked well.

In comparison with Windows programs, the feature sets offered by most of these applications are limited. For example, the preview version of Lotus eSuite WorkPlace, a productivity suite, did not include a spell-checker. Others, such as IQ Net's IQSuite, a stock analysis tool, and Novita's e-mail client LiveLetter, were surprisingly capable.

Performance remains a problem for Java applications. Since Java is a semi-interpreted language (the VM must interpret the byte code for your machine), Java applications run slower than those compiled into native code for a specific platform.

Finally, despite Java's premise of platform independence, compatibility remains an issue as well. Some applications include their own Java runtime environments and didn't work properly with other environments on different platforms.

To be sure, Java applications aren't without their problems. But the quality and quantity of applications have increased rapidly. Ultimately, the potential of Java outweighs its current problems, and in the coming years, commercial applications written in Java will win a place on many desktops.

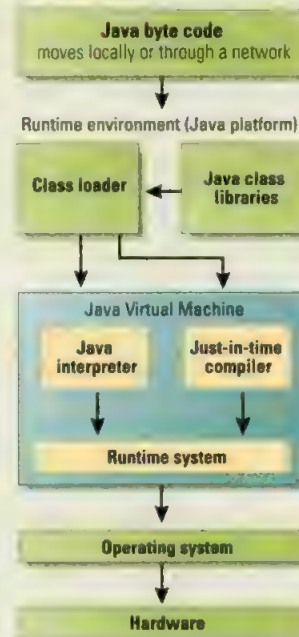
The Java Platform

The Java platform or runtime environment is the platform that enables Java applications and applets to run on any system regardless of the operating system and underlying hardware.

Rather than compiling code into a format designed for a specific platform, developers compile Java source code into an intermediate form of byte code that can be executed on any system with a runtime environment.

The class loader transfers the Java byte code to the Java Virtual Machine (VM). The heart of the Java platform, the VM interprets or compiles byte code for that specific platform. Java class libraries—the files that make up the standard API (application programming interface) for applications and applets—are also loaded dynamically.

The runtime system then executes the interpreted or machine code on that platform. The program may be run within a browser (as an applet) or as a standalone application.



Source: Sun Microsystems' Java Platform White Paper

Our Contributors: PETER COFFEE is an advanced technologies analyst for PC Week Labs. GREG ALWANG is a contributing editor of *PC Magazine*. STEPHEN PLAIN and NEIL RANDALL are frequent contributors, and SEBASTIAN RUPLEY is a senior editor of *PC Magazine*. DIANE JECKER was the project leader, and JOHN MORRIS was the associate editor in charge of this story.

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Productivity Applications

By Peter Coffee

In the battle to establish Java as a viable platform, productivity applications (and office suites in particular) have become a test case. The reason is obvious: Most users spend the majority of time using productivity applications. Thus, if Java-based office suites could be made to work, then other applications would inevitably fall into place. At least, that's how the thinking goes. In practice, Java is having a tough time penetrating this market, and it is by no means assured of a successful verdict.

Indeed, early efforts were not encouraging. The first attempt, Corel Corp.'s Corel Office for Java, attempted to duplicate the core features of Corel WordPerfect Suite. But users found the trade-off in features and performance to be too great,

and the suite never shipped. Since then, Corel has reorganized its efforts around a client/server-based Java architecture code-named Remagen.

Even more telling is the fact that now, one year later, the choices for Java-based office suites remain very limited. The only suite that was available to test was a preview version of Lotus eSuite Workplace.

Applix is set to release a new version of its Anyware Office, Version 4.4, but this was not ready in time for our story. Cooper & Peters was purchased by Microsoft Corp. shortly after our story last year (*PC Magazine*, "The Complete Java Guide," May 27, 1997), and its future is unclear. Star Division's StarOffice for Java is not yet available. These products, plus Corel's WordPerfect Enterprise Edition, are discussed in the

sidebar "Preview: Java Office Suites."

Despite its sluggish start, Java does offer some potential advantages in this space. Perhaps most significant is its ability to transform the office suite into a modular and easily customizable desktop. For example, users could download tools such as a spell-checker as needed. The surprisingly swift deployment of the JavaBeans component technology and tools such as Lotus eSuite DevPack is helping to promote this concept.

And Java is making inroads with more focused productivity applications. Some of the other programs reviewed here include project management and collaboration tools, as well as charting and reporting applications. Clearly, the jury is still out on Java as a platform for everyday productivity applications.

OFFICE SUITES

Lotus Development Corp.

Lotus eSuite Workplace

In the familiar "tastes great, less filling" debate, Lotus eSuite Workplace definitely comes down in favor of fewer calories.

This Java-based productivity suite consists of a small subset of the Lotus 1-2-3 spreadsheet, a basic Web browser, and a word processor, plus a few miscellaneous tools such as a personal information manager and a presentation graphics program.

As an early demonstration of what Java may be able to do, the preview version of eSuite that we tested is significant. In practice, however, we found it has a way to go, especially in terms of performance. The memory requirements of eSuite were surprising and comparable to the combined demands of Microsoft Excel, Microsoft Word, and Netscape Navigator—a trio providing far better user experience.

Of course, eSuite occupies a much smaller hard disk footprint than those applications, and Lotus Development Corp. promises that the suite will cut administrative and support costs. But it's clear that this product will have to undergo substantial improvement in both capabilities and performance before companies will replace desktop PCs running Windows office suites with NCs running eSuite.

On our test machine, a 133-MHz Pentium with 64MB of RAM running Microsoft Windows NT 4.0, eSuite gave a leisurely performance. Whether we were entering text, popping up

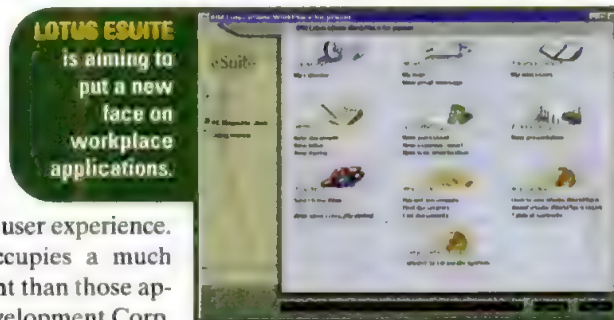
menus, or loading simple Web pages, eSuite seemed to labor.

In this first version, eSuite's feature set is relatively spartan. The word processor does not have a spell-checker, and you cannot select a range of cells in a spreadsheet by dragging the mouse (you must select them by name). Lotus says the next release, due by the middle of this year, will add both features. The spreadsheet's formula functions are also quite limited.

The interface has a retro look but was easy to understand and use. Our only complaint is that it sometimes failed to provide proper feedback. Often, we had to go back and click a button again, this time holding it down a little longer, to make something actually happen.

One of eSuite's key selling points is that it's highly customizable. The desktop can be configured to display only those applications and applets required by the user. Furthermore, each application can be customized to include just the necessary features. Lotus eSuite DevPack, also currently in preview, offers a set of JavaBeans components for customizing the environment.

Lotus's eSuite should generate some stimulating conversations between enterprise IT architects and networked users. But at this point, it's only a proof of concept for Java productivity applications, and by no means the last word.—Peter Coffee
Lotus Development Corp., Cambridge, MA; 800-346-4010, 617-577-8500; esuite.lotus.com. Choose 505 at www.pcmag.com/infolink.



STANDALONE APPLICATIONS

Netmosphere Inc.

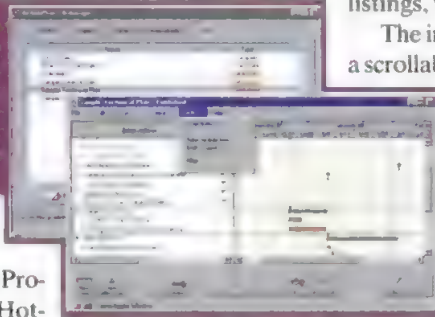
ActionPlan

A real-time collaborative tool for planning, coordinating, and tracking projects and resources, ActionPlan uses familiar project outline and time line metaphors. But it has the added benefit of letting dispersed team members access project information via Java applets. In addition, ActionPlan (\$200 list per user for 100 users) can utilize a Marimba Castanet Transmitter to distribute applets to team members. (Castanet is a platform for pushing Java applications and updates to users.) Unlike WebProject, an enterprise-level Java project management system, ActionPlan is targeted at workgroups.

The ActionPlan screen includes four tabs: Projects, Users, Roles, and Availability. The HotSheet applet contains a snapshot of each individual's tasks along with the status and due dates. You can copy your HotSheet data locally to work off-line or configure it to send you overdue or modified tasks automatically via e-mail. And ActionPlan can import and export Microsoft Project files.—Greg Alwang

Netmosphere Inc., San Mateo, CA; 650-655-2031; www.netmosphere.com. Choose 529 at www.pcmag.com/infolink.

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Divya Inc.

InfoBook

A standalone Java application or applet that can be plugged into existing Web pages, Divya's infoBook 2.7 is a configurable database-access tool that presents text and multimedia data in a searchable format. In addition, infoBook is ideal for Web designers who need to provide quick access to large amounts of data, such as products or real-estate listings, via a concise interface.

The infoBook applet consists of three windowpanes: a scrollable record list, a record-detail area, and a multi-

media area for displaying graphics and playing sound files. Convenient navigation buttons let you go through the records or search based on any field. With over 70 configurable parameters, infoBook is highly customizable, and you can even include your own graphics and messages in the integrated banner and ticker-tape applets. And you can

push updates to users via Marimba Castanet.

In the past two years, infoBook has grown into a mature applet that is suitable for a range of professional applications. A single-server version can be downloaded for \$199 (list), and a developer license is available for \$399 (list).—GA

Divya Inc., MacLean, VA; 703-861-5282; www.divya.com. Choose 530 at www.pcmag.com/infolink.

Preview: Java Office Suites

When Lotus eSuite WorkPlace ships, Lotus will become the first major vendor to test the demand for Java productivity suites on corporate desktops. In that sense, eSuite will become a bellwether for networked computing. But Lotus is by no means the only vendor pursuing this arduous task, and IT professionals will find several other options worth evaluating when developing a thin-client strategy.

Perhaps the most advanced Java office suite, Anyware Office, was between versions at the time of our testing. Version 4.4 should be shipping from Applix by the time you read this. Like eSuite, this product is designed for a connected user who needs transparent access to networks.

Anyware Office runs within any Java-capable browser and offers a comprehensive set of productivity tools including a word processor, graphical spreadsheet, e-mail client,

HTML authoring program, and database-access front end. The applications take advantage of the networked environment. For example, spreadsheets can contain links to dynamic data that resides on a network.

Notably absent from our main roundup, Corel Corp. has regrouped since pulling the plug on its Corel Office for Java. Its new strategy is based on a thin-client framework code-named Remagen, which employs Java clients and Windows NT Server on the back end. Corel is also developing Corel WordPerfect Enterprise Suite, based on Remagen. It will include versions of Paradox, Presentations, Quattro Pro, and WordPerfect.

Like Lotus, Corel is also developing a modular desktop as part of its Java strategy. Code-named Alta, this clean-desk interface lets IT professionals customize desktops using JavaBeans components and XML (eXtensible

Markup Language). Corel claims Alta will provide 90 percent of the productivity tools most users require.

Sun Microsystems is also planning to offer a desktop environment based on Java. Called HotJava Views, the suite will include an e-mail client, calendar, personnel directory, and integrated browser. Designed to run on NCs replacing 3270-style terminals, HotJava Views does not include a word processor, spreadsheet, or presentation program. It is slated to ship by the middle of this year.

Finally, Star Division, a German software maker producing an office suite popular in Europe, is also developing a Java suite called StarOffice for Java. StarOffice includes word processing, spreadsheet, e-mail, charting, and graphics applications. It's also compatible with Microsoft Office. And Star Division is developing a version for NCI's NC Desktop as well.—PC

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- Dell Comfort Key Keyboard

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- DVD Multimedia Subsystem: 2X DVD-ROM Drive and Decoder Card
- NEW Turtle Beach Montego A3D 64 Voice Sound Card
- Altec Lansing ACS-295 Speakers with Subwoofer
- Dell Comfort Key Keyboard

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- 64MB SDRAM Memory
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- STB nVidia 4MB 3D AGP Video Card
- 32X Max⁴ Variable CD-ROM Drive
- NEW Turtle Beach Montego A3D 64 Voice Sound Card
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- Iomega Zip 100MB Internal Drive
- Dell Comfort Key Keyboard

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DELL DIMENSION XPS D233 233MHz PENTIUM II PROCESSOR FEATURING MMX TECHNOLOGY

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- STB nVidia 4MB 3D AGP Video Card
- 32X Max⁴ Variable CD-ROM Drive
- NEW Turtle Beach Montego A3D 64 Voice Sound Card
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Common features listed above plus:

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- 3.2GB ATA Hard Drive
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- 32MB SDRAM Memory
- 3.2GB ATA Hard Drive
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- MS Office 97 Small Business Edition
- 6.4 Pounds*

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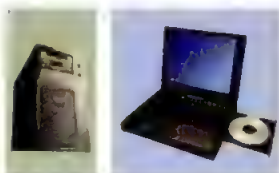
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NetFactory Inc.

NetCharts, ChartBlaster

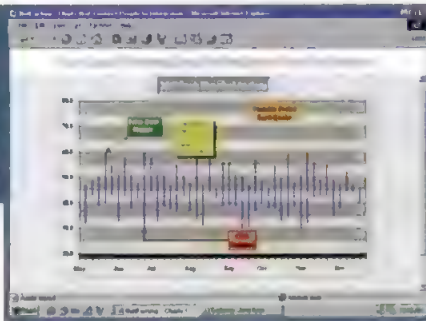
A Java-based charting engine, NetCharts (\$795 list per server), from NetFactory, lets you add live, interactive charts to your Web pages. To display charts, you load NetCharts on your Web server and place calls to its rendering applets in your Web pages, so you must be familiar with HTML in order to customize the chart parameters. For noncoders, NetFactory offers ChartBlaster (\$495 list), which provides a GUI interface for visually painting the HTML chart files that call NetCharts.

NetCharts offers nine configurable charting formats, chart legends, annotations, fonts, colors, and interactive drill-down components activated by mouse movements or mouse clicks.

ChartBlaster runs as a standalone Java application and requires Sun's JDK (Java Development Kit) or Java runtime files. If charts don't need regular updating, ChartBlaster lets you save them as GIF files. Both ChartBlaster and NetCharts support JDBC (Java Database Connectivity), so live chart data can be extracted from any standard database.—GA

NetFactory Inc., Silver Spring, MD; 301-625-5600; www.netcharts.com. Choose 531 at www.pcmag.com/infolink.

NETCHARTS AND CHARTBLASTER display dynamic views of data on the Web.



Seagate Software Inc.

Seagate WebAccess Desktop

S eagate WebAccess Desktop taps Java technology to extend the reach of Seagate Software's Crystal Info 6, a popular ad hoc reporting and analysis tool for the enterprise. Like the Microsoft Windows-based Info Desktop client, WebAccess Desktop lets you request reports or, if using an OLAP add-in, info cubes (multidimensional views) of data. But WebAccess Desktop can retrieve reports securely from any PC with a Web browser and Internet access.

WebAccess Desktop closely resembles Info Desktop, which uses an expandable tree view of report directories and provides access to report properties. Once you retrieve a report, you can sort and subtotal columns and drill down to see more details.

To boost performance for users connecting over the Web, Crystal Info uses a page-on-demand technique to feed only one page at a time to your browser. In addition, support for Microsoft's Active Channel and Netscape's Netcaster technologies lets you push updates and new reports to users.—GA

Seagate Software Inc., Vancouver, BC, Canada; 800-877-2340, 604-681-3435; www.seagatesoftware.com. Choose 532 at www.pcmag.com/infolink.

WebMan Technologies Inc.

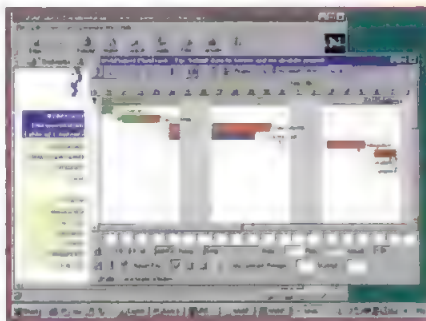
Timecruiser

A Web-based time management system, Timecruiser—from WebMan Technologies—offers high-end calendaring features such as recurring events, multiple access levels, multicalendar views, event forwarding, and group scheduling. Using Timecruiser, you can check and update your schedule from any PC. This makes the product ideal for interspersed workgroups.

With Timecruiser, you designate your calendar as public or private and specify which users have access. Groups can be pre-defined and granted exclusive access to specific scheduled events. The tabbed interface is extremely easy to navigate and provides quick access to various calendar views and functions. Timecruiser's auto-save feature periodically refreshes data.

To add spice to your calendar, Timecruiser lets you attach multimedia files and Java applets to events. Timecruiser is extensible through WebMan's calendar applet API, called Cappellet. The basic package costs \$650 (list) for 25 calendars; the Enterprise Edition, offering ODBC/JDBC support, costs \$2,650 for 25 calendars.—GA

WebMan Technologies Inc., Montville, NJ; 888-202-3521, 973-244-7856; www.timecruiser.com. Choose 533 at www.pcmag.com/infolink.



WebProject Inc.

WebProject

D esigned for the enterprise, WebProject is more than a Java-based project management tool; it's a powerful collaboration and communication tool. Through real-time chatting, voting, e-mail notifications, and threaded discussions, WebProject facilitates all aspects of project communications among distributed organizations and team members.

WebProject (\$490 list for the server and starter pack) is based on a three-tier architecture and consists of several applets for planning, analyzing, and administering projects. It works best when coupled with a back-end database such as Oracle or Microsoft SQL.

A main log-on applet provides access to the WebProject modules and includes links to automated server-side reports, so you instantly access current project statistics. WebProject lets you import data from (and export it to) nearly all major project management packages.

Threaded discussions can be based on project tasks, and team members can vote on any discussion topic. The chat feature lets you hold moderated, virtual project-status meetings.—GA

WebProject Inc., Foster City, CA; 650-574-0578; www.wproj.com. Choose 534 at www.pcmag.com/infolink.

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CDW 100404



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\$1977³⁷

CDW 100405

133MHz INTEL PENTIUM® MMX

TOSHIBA

Satellite Pro 440CDX

► 133MHz Intel Pentium® processor with MMX™ technology ► 256KB Level 2 cache ► 16MB EDO RAM standard ► 1.34GB hard drive ► 10X CD-ROM drive ► 12.1" FastScan dual-scan display ► 8-bit color at 800 x 600 resolution ► Windows® 95 or Windows for Workgroups V3.11 operating system ► Weight: 6.9 lbs. ► 3-year parts and 1-year labor warranty

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Deskpro 2000

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HP Brio 8014 PC

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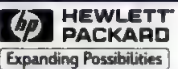
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Deskpro 2000

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Financial Applications

All reviews by Sebastian Rupley

Finance is a data-intensive field, so it's little surprise that sites for online trading and financial planning are thriving on the Web, which specializes in timely delivery of data. Java-based applications take this a step further, adding some of the functionality found in Windows applications such as Window on WallStreet and Omega Research's Supercharts. We tested two technical charting and analysis tools, IQ Net's IQSuite and Equis International's MetaStock for Java, designed for day (and other short-term) traders.

One of the main advantages of these Java-based tools is cost. Both are free downloads. IQSuite, however, does require a monthly subscription. In addition, you can download price data

throughout the day rather than once a day, as is typically the case with Windows-based programs. Though stock charts on the Web are nothing novel, the new Java charting products produce live charts that users can manipulate, instead of the static pictures of charts found on other sites.

Of course, there's no such thing as a free lunch, and these Java-based tools don't include the same depth of features as products like Window on WallStreet. They do provide many of the most popular market indicators—Bollinger Bands and Moving Averages—but not more advanced indicators such as Percent Retracement charts and Accumulation/Distribution. The Java tools also have more basic interfaces, are less adept at charting multiple indicators on one chart, and don't offer real-time charting for day traders.

Still, the Java tools can be a cost-effective alternative for many users. For example, if you want to view three years' worth of price action in Coca-Cola stock along with the stock's moving average, these tools are easily up to the task.

Other types of financial applications are appearing in Java versions on the Web as well. Home Account Network's Balancer and Bill Pay, for instance, let users automate banking and bill payment. And Java applications designed for trading and charting many kinds of financial instruments other than stocks—including bonds and options—are also heading for the Web in free versions.

Java is a natural platform for applications that use the Internet to exchange data frequently. Its stock is rising in the financial software market.

IQ Net Corp.

IQSuite

The most advanced Java-based technical-analysis product available on the Web, the free IQSuite, from IQ Net Corp., offers more market indicators than competitors do. These additional capabilities come at a price, however. A subscription to IQ Net's service costs \$18.95 a month (the first month is free).

IQSuite offers several features usually found only in retail technical-analysis products. For example, it has over 20 technical indicators, compared with the 14 in Equis International's MetaStock for Java. IQSuite also offers charts updated on an intraday basis (5 minutes, 15 minutes, 30 minutes, and 60 minutes) rather than an end-of-day basis. This last feature makes it the best of the Java-based products for day traders.

IQSuite also has a search engine that allows you to cull through a database of more than 10,000 stocks based on criteria in more than 100 categories such as industry group, price/earnings ratio, earnings per share, and so on. A more basic version of the stock-screening module, called Scan, is available on IQ Net's site (www.iqc.com). Other key features to consider in IQSuite include audio and visual alerts issued when a stock price reaches a user-specified level.

Beyond the shadow of a doubt, IQSuite is the best Java charting product available today.

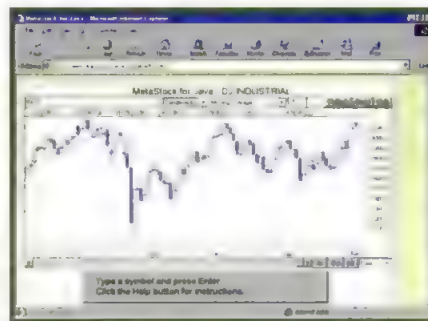
IQ Net Corp., City of Industry, CA; fax, 909-598-3266; www.iqc.com. Choose 535 at www.pcmag.com/infolink.

Equis International Inc.

MetaStock for Java

The Windows version of MetaStock is regarded by many traders as the best technical-analysis product. MetaStock for Java, from Equis International, is not as robust—lacking the expert system designed to provide text-based analysis of prices and technical indicators, for example—but goes miles beyond the static charts found at other financial sites.

MetaStock charts can be viewed in daily, weekly, or monthly formats and include data going as far back as 1993. You can choose from 17 technical indicators, including such advanced ones as Accumulation/Distribution and Stochastics.



METASTOCK FOR JAVA helps you to make sense of the stock market.

More common indications, such as Moving Averages and Bollinger Bands, are also available. A click of the mouse within a chart on any given day will pop up last-minute high, low, close, and volume information.

Users won't find as many technical indicators in MetaStock for Java as in IQ Suite, but the former product is completely free, whereas the latter costs \$18.95 a month. Users who don't need IQSuite's more advanced set of technical indicators will find MetaStock for Java a useful trading ally.

Equis International Inc., Salt Lake City; 800-882-3040, 801-265-8886; www.metastock.com. Choose 536 at www.pcmag.com/infolink.

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Internet Applications

All reviews by Neil Randall

Java may have its work cut out for it on the desktop but has quickly proven itself to be a player on the Internet. Therefore, we weren't surprised to find a rich assortment of Internet applications written in Java. Though few offered the seamless installation and setup we've come to expect from Windows applications, many are noticeably full-featured. And because of their special capabilities, they offer some advantages that Windows counterparts can't match.

The applications reviewed here can be divided loosely into three categories: e-mail clients, chat and messaging programs, and utilities. In each category, you'll find numerous products, but for this story, we've isolated some of the more

feature-rich ones. You'll find more reviews of similar products at our Web site (www.pcmag.com).

The main advantage to using Java for Internet applications is obvious. Since Java is platform-independent, you can run a Java application and access data from virtually anywhere. For example, the two e-mail clients reviewed here, NetAccent's Dart-Pro and Novita LiveLetter, let you retrieve mail from POP3 and IMAP mail servers—from any system with an Internet connection and a Java-capable browser.

LiveLetter is also a relatively full-featured e-mail client with support for MHTML and LDAP and for message filters. But unless you have a real need for e-mail that is accessible from any Internet terminal, neither of these clients is likely

to convince you to ditch Microsoft Outlook or Qualcomm's Eudora Pro.

Other Java-based Internet applications offer some features that may be harder to find in Windows programs. For example, Activerse's Ding! is a client/server-based People Browser that helps you to keep track of who's online and quickly communicate with those who are. For Webmasters, MerzCom's MerzScope and Innotech Multimedia Corp.'s NetResults make it easier to find the right information at your site.

Our only complaint with these applications is that installation was troublesome. In some cases, we had to edit initialization files to get programs up and running. Aside from these minor issues, when it comes to Internet applications, Java's future seems secure.

E-MAIL CLIENTS

NetAccent Inc.

Dart-Pro

The main advantage of a Java-based e-mail program such as NetAccent's Dart Mail is that it gives you the ability to access your account from any PC with an Internet connection and a browser. Dart Mail is available in three versions: Dart-Lite, a POP3-only client; Dart-Pro, which also supports IMAP4; and Bulls-Eye, which combines Dart-Pro with a proxy server. We tested the Dart-Pro client.

Dart-Pro lets you add, create, and rename mail folders and subfolders and maintain a personal address book—all on an IMAP server. The e-mail client supports file attachments in text, graphics, audio, and video formats. Each format has its own icon, so you can gauge approximately how large an attachment is likely to be before deciding whether or not to download the message. Messages can be dragged and dropped between folders locally on the server. One especially useful feature automatically asks if you want to resend mail that was not delivered successfully.

Dart-Pro will work with a POP3 server, but it is much less efficient, because all messages (instead of just the header) must be downloaded. The product doesn't offer advanced features such as message filtering, and its installation process could use some work; we had to edit an initialization file to get it up and running. But Dart-Pro fulfills its purpose as a flexible mail client for mobile users.

NetAccent Inc., Downers Grove, IL; 630-435-5903; www.netaccent.com. Choose 537 at www.pcmag.com/infolink.

Novita Communications Inc.

Novita LiveLetter

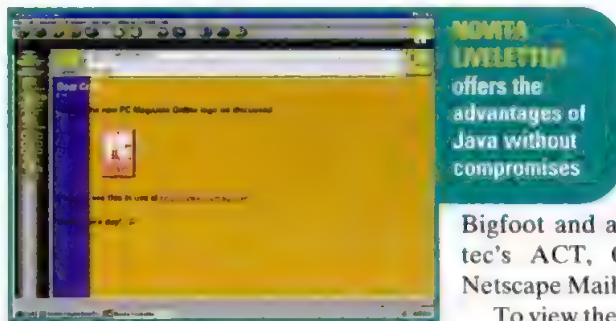
If you're growing tired of plain old text messages, Novita LiveLetter (\$40 street), from Novita Communications, could be the cure. LiveLetter messages are composed in MIME-HTML (MHTML), so you can include multimedia elements such as graphics and sound. With its multimedia focus and colorful interface, LiveLetter will appeal most to those who need a home or personal e-mail client.

Installation of LiveLetter was a snap, and the program was also a pleasure to use. It lets you compose in WYSIWYG HTML, and you can drag and drop HTML documents and Java applets into your messages. The program includes

message filters, a system for handling multiple POP mailboxes, and an LDAP-compliant address book which works with both public-directory services such as

Bigfoot and address books for Symantec's ACT, Qualcomm's Eudora, or Netscape Mail.

To view these messages in their richest possible format, your recipients need either LiveLetter, an MHTML-capable Web browser, or the free LiveLetter Viewer bundled with Sun Microsystems' HotJava browser. LiveLetter is more than just a pretty face; it's a robust Java mail client that will add some character to your communications. **Novita Communications Inc.**, Santa Clara, CA; 408-588-1400; www.novita.com. Choose 538 at www.pcmag.com/infolink.





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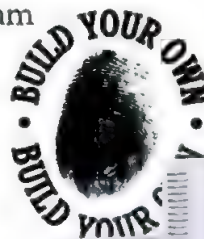


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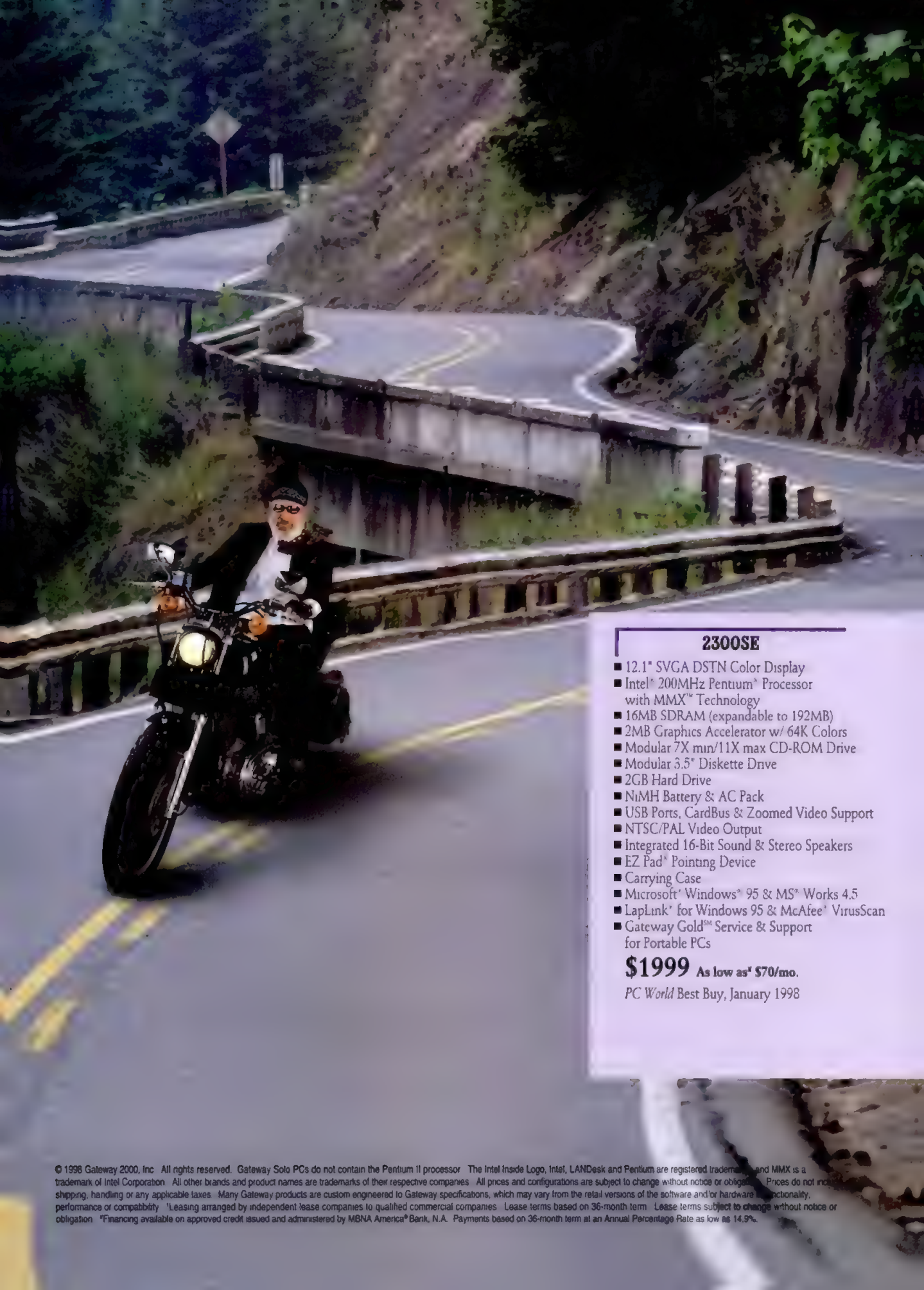
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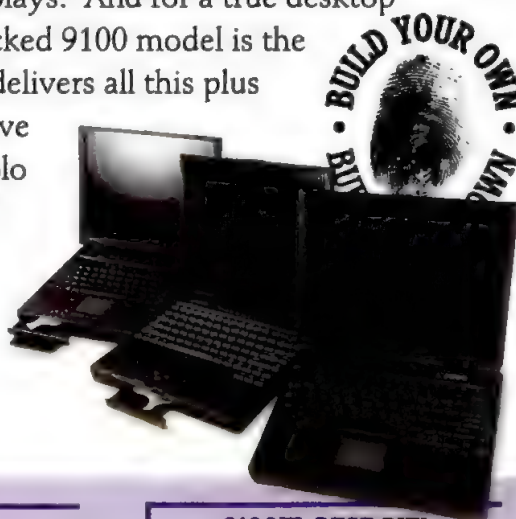
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CHAT & MESSAGING

Activeverse Inc.

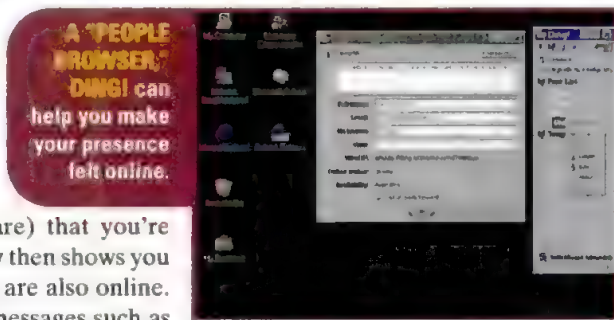
Ding!

To get a sense of what Activeverse's Ding! can do, think of it as an office in/out board with the immediacy of the telephone and the reach of the Internet. Labeling itself a "people browser," Ding! (\$29.95 list per client) gives individuals a means of establishing a presence on a network and maintaining contact with colleagues no matter where they work.

Ding! relies on its server-side software for much of its functionality, and getting started with the program can take some time. The clients were easy to use, however. You begin by informing the Ding! "switchboard" (the server portion of the software) that you're online. The Ding! window then shows you any peers or friends who are also online.

Users can post short messages such as "Available for emergencies only" to inform others of their status. Ding! also works as a messaging client, letting you exchange messages that can include live URLs. You can enter a peer-to-peer chat session with invitees, and you can use Ding! to transfer files.

Activeverse Inc., Austin, TX; 800-235-9274, 512-708-1255; www.activeverse.com. Choose 540 at www.pcmag.com/infolink.



Volano LLC

VolanoChat

A full-featured chat package, VolanoChat 2.0 (\$500 street), from Volano LLC, offers you the ability to do everything from adding private chat rooms to displaying banner advertising on your chat site. Install the package on the server and when users log on through their browsers, they automatically download the associated chat client as a Java applet. The applet supports all the typical chat functions, including working with separate chat rooms simultaneously and even sending audio notification to other chatters to let them know they've arrived.

VolanoChat worked flawlessly for us from the first installation. The server software provides extensive control over the creation and management of chat rooms. You can create unlimited public chat rooms, as well as *dynamic* rooms, each available only from the Web page that generates it. Rooms can be configured with different colors, text messages, character string limits, and advertising banners.

The rooms can be individually monitored and offending parties banned altogether. VolanoChat comes in a Pro version (\$595 to \$3,495 list) for database connectivity and private chat rooms.

Volano LLC, San Francisco; 415-587-4297; www.volano.com. Choose 539 at www.pcmag.com/infolink.

INTERNET UTILITIES

MerzCom Inc.

MerzScope

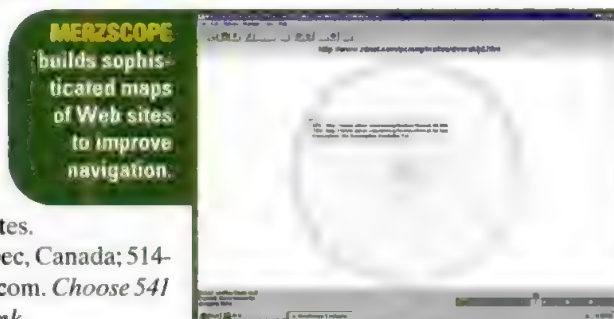
A Java-based Internet utility, MerzCom's MerzScope (\$395 list) lets you create detailed maps of your Web site or intranet. You can produce a map that shows the relationships among the various pages, and you can annotate the map and provide navigational guides. Once the map is completed, you can publish it so visitors can use it as a navigational tool.

The power of MerzScope lies in its annotation capabilities. The ability to add graphics, links, and text to the map means that you can give your users a much more detailed guide to your site. When you combine the annotation functions with MerzScope's zoom features, your site map becomes a true map.

MerzScope maps can be presented in one of two formats. The first shows links among parent and children nodes but not among children; the latter shows the relationships between children as well. You can hide any nodes and establish various points of view to aid navigation further.

More than a demonstration of Java technology, MerzScope is a rich tool for enhancing Web sites.

MerzCom Inc., Laval, Quebec, Canada; 514-973-5852; www.merzcom.com. Choose 541 at www.pcmag.com/infolink.



Innotech Multimedia Corp.

NetResults

Innotech Multimedia's NetResults is a server-based application that indexes any text-based files. Once indexed, the information can be searched from a Web browser using an included Java applet.

Installing NetResults was tricky, but the Readme file cleared up our problems. Once the software is installed, you can access the NetResults area of your Web server (as the site administrator) and click on the Index command. As an administrator, you can set precisely which resources your users will be allowed to search, including multiple indexes. Or you can simply choose the AutoIndexer and let NetResults index all the HTML files on your site.

Users access the information via a Java applet that you place on the home page. They can perform a variety of search types, including searches of the local index and a cascading search that combines results from several different NetResults indexes on different servers. The full version of NetResults costs \$995 (list) per server. A Lite version, which limits you to indexing 500 documents and does not support cascading searches, is also available for \$199.

Innotech Multimedia Corp., North York, Ontario, Canada; 416-492-3838; www.netresults-search.com. Choose 542 at www.pcmag.com/infolink.

Utilities

By Stephen Plain

Utilities have always played a critical role in personal computing. They fill the gap between what applications can do and what users need to do. In the past, however, utilities were designed for specific operating systems. Whether a utility's function was to enhance the operating system itself or was related to a particular application, it was always compiled for a particular platform such as DOS, Macintosh, 16-bit Windows, or 32-bit Windows.

Given that Java has an inherent cross-platform architecture, its utilities are linked more to functionality than to enhancing the performance of a particular OS. For that reason, they will never replace utilities that tweak the workings of Microsoft Windows. Rather, they coexist as a separate market

altogether. Some Java utilities combine traditional chores with the advantages of Java. Others leverage the power of Java in a networked environment to provide completely new functionality.

One natural role for Java utilities is content management. After all, most Internet and intranet applications are about delivering content to their users. Java applets are a perfect vehicle for customizing the look and feel of a Web site—and for presenting content to the end user in innovative ways. ION Web Products' EZ Text and Live Picture's Live Picture Viewer, reviewed here, are examples of Java utilities that provide better ways to display text and images on Web pages.

The introduction of JavaBeans has expanded the potential for Java utilities. JavaBeans are reusable components that

can be plugged in to existing Java applications. This architecture makes it easy to create third-party add-in tools. Inso's International ProofReader for Java, also reviewed here, is a good example of how Beans can be used to build utilities. Developers can add these components to their own applications and give them sophisticated spell-checking features.

On our tests, we discovered that the Java utilities market is still finding itself. Often, we had to consult the accompanying Readme files to determine which files to copy to our hard disk for getting the programs running. This is partly because many utilities are targeted at experienced developers and Webmasters. But a handful were packaged and well documented, and the number in this category should increase as this market matures.

Divya Inc.

BackOnline

The first 100% Pure Java-certified backup tool, Divya's BackOnline is a client/server solution that works on both intranets and the Internet. It provides remote data backup and off-site storage. We tested a public beta 2 version of BackOnline. This utility is ideal for mobile users or remote offices looking for an inexpensive backup solution with the option to access archived data from anywhere using a Web browser. Because the data is stored on the server, BackOnline does not require removable storage devices.

The multithreaded BackOnline Server handles the backup and restore requests and is used to set up user accounts, privileges, and storage restrictions on the server. The server is compact (only 80K), but it is also robust, supporting load balancing between multiple servers.

The 365K BackOnline Client applet lets users set backup and restore parameters or create a backup schedule. For speed, the BackOnline Client compresses data on the fly and uses 56-bit DES encryption to keep your data secure. When restoring, data is not decrypted or uncompressed until it arrives at the client.

The release version of BackOnline should be available by the time you read this. Pricing is based on the number of concurrent users and ranges from \$10 to \$29.50 (list) per user.—GA

Divya Inc., MacLean, VA; 703-861-5282; www.divya.com. Choose 543 at www.pcmag.com/infolink.

ION Web Products Inc.

EZ Text

A browser within a browser, ION Web Products' EZ Text (\$34.95 list) is a utility that lets Webmasters present content in a new way. By embedding EZ Text applets within Web pages, you can create custom boxes that display text and graphics.

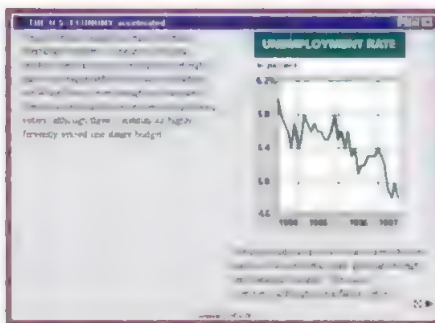
The EZ Text applet appears in a Web page as a framed or unframed box of any size you choose. When a text file is linked to the applet through tags, the beginning of the file is displayed in the box. A small black arrow lets the user expand the view. Clicking on the arrow opens the entire file in a document browser that enables the user to read long documents without

scrolling up and down. The EZ Text interface includes Home, Previous, and Next buttons, as well as buttons that increase and decrease font size.

You can make EZ Text display in-line GIF files by prefacing the filenames with an @ in the text file, and you can place multiple instances of the applet in a single Web

page. Using multiple applets on a page, you can make attractive-looking online newsletters with separate articles linked to each. EZ Text enhances the browsing experience and will attract users back to your site time and time again.—SP

ION Web Products Inc., Crystal City, MO; 888-466-5282, 314-937-9094; www.ionwebproducts.com. Choose 544 at www.pcmag.com/infolink.



EZ TEXT creates a window within Web pages that displays text and graphics.

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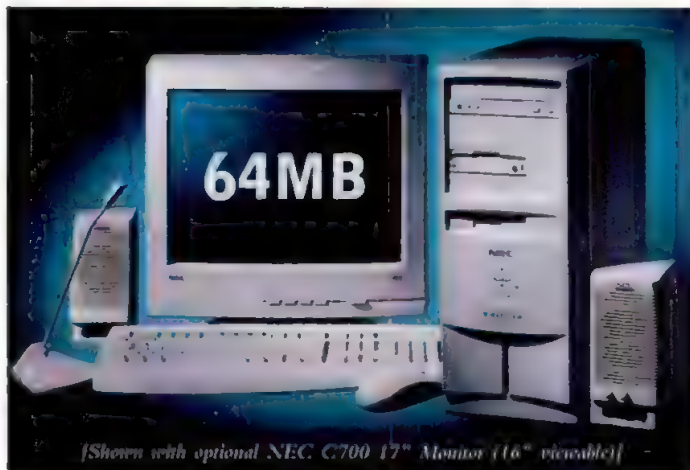
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Inso Corp.

International ProofReader for Java

Inso Corp. specializes in proofing tools, and its products appear in major applications such as Lotus WordPro, Microsoft Word, and Netscape Navigator. International ProofReader for Java (IPR) is a JavaBean that is targeted at software developers. IPR is licensed to developers and is not available to end users.

This JavaBean provides basic spell-checking features such as suggestions, custom dictionaries, and a standard English lexicon of over 180,000 entries. According to Inso, the lexicon includes modern computing, financial, and legal terms. IPR also checks punctuation and capitalization.

The standard interface is straightforward, with a suggestion box and buttons you use to change, add, or skip words. The interface is fairly flexible, however. You can selectively show or hide the buttons as well as customize the captions for the buttons and status messages.

International ProofReader for Java is simple enough to implement quickly yet flexible enough to integrate smoothly into applications.—SP

Inso Corp., Boston; 800-733-5799, 617-753-6500; www.inso.com. Choose 545 at www.pcmag.com/infolink.

Live Picture Inc.

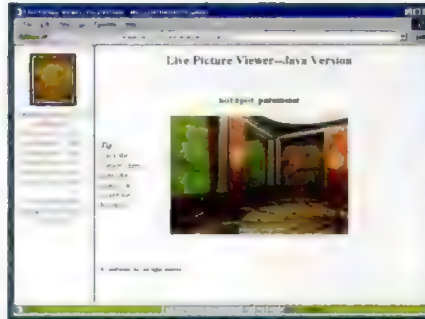
Live Picture Viewer—Java Version

Live Picture Viewer—Java Version is a free applet that enables users to browse panoramic images created using Live Picture's PhotoVista (\$79 direct). The applet lets Webmasters make 360-degree panoramic images available to anyone with a Java-compatible browser, without the need for a plug-in or external program.

This applet weighs in at only 40K and does a fine job of displaying panoramas in a

smooth and inviting manner. With the applet, you can pan around the image, look up and down, and zoom in and out.

LIVE PICTURE VIEWER brings the power of panorama to the Web.



Webmasters can also embed hot spots using simple JavaScript code. As the user scrolls around the panorama, hot spots appear as red, target-like icons. Live Picture Viewer can also

present automated guided tours and play RealAudio streams in response to user clicks, making it useful for creating virtual tours. The appeal of Live Picture Viewer is that when combined with PhotoVista, it lets you easily create an experience that visitors to your Web site won't forget.—SP

Live Picture Inc., Campbell, CA; 800-724-7900, 408-371-4455; www.livepicture.com. Choose 546 at www.pcmag.com/infolink.

SFS Software

javaZIP

Generally, Java-based programs offer a subset of the features you typically find in native Microsoft Windows applications. But that's not the case with SFS Software's javaZIP, Version 2.0 (\$49 direct)—a full-featured file compression program that offers some unique features.

The key advantage to javaZIP is that it lets you create archives containing files from multiple folders and subfolders—even from different volumes—in the same session. You simply create a new archive and then click the Import button to open an Explorer-like tree from which you can pick and choose files at will.

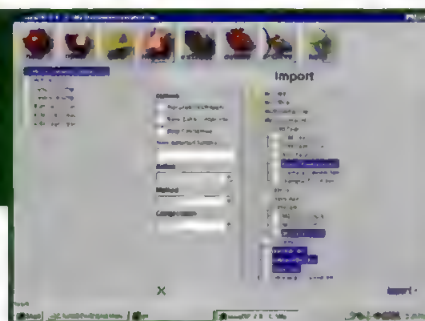
JavaZIP includes its own JRE, and we had no problems getting it installed and running. The graphical interface includes large, colorful toolbar buttons similar to those in Nico Mak's WinZip.

Other extras include support for JAR (Java Archive) files and integrated file viewers for text, binary, GIF and JPEG, Java class, VRML, HTML, and ZIP files. A trial version of this impressive utility is available at the vendor's Web site.

—John Morris

SFS Software, Schmalkalden, Germany; +49 172 4714485; www.sfs-software.com. Choose 548 at www.pcmag.com/infolink.

JAVAZIP offers all of the features of a native Windows utility.



Mark Watson

PicWeb Builder

Like many valuable utilities, Java-based PicWeb Builder 2.2 is designed to address a single, routine task. This shareware program (\$5 registration fee) parses directories containing JPEG and GIF images, creates GIF thumbnails of all the images, and places them in HTML pages, ready to be published on your Web site.

PicWeb prompts you for a top-level directory where images are located, and a Process button tells the program to begin generating thumbnails. An Options screen lets you choose among small, medium, and large thumbnails, and gives you the option of including the image filenames in the HTML pages. The program creates a Pics.htm file containing thumbnails and, if there are subdirectories containing more images, links to similar pages in those directories.

There's nothing fancy about the HTML pages that PicWeb automatically generates, and you'll probably want to spruce them up yourself. But they let users open the full-size images by clicking on the thumbnails. PicWeb builder is a quick and easy way to create contact sheets for the Web.—SP

Mark Watson, Sedona, AZ; 520-203-0146; www.markwatson.com. Choose 547 at www.pcmag.com/infolink. **PC**

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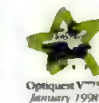
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* Aperture grille pitch



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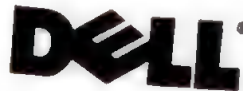
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ENVIRONMENTS

BY LARRY SELTZER

The promise of Java is that any application written to the Java specification will work on any OS running the correct version of the Java environment.

We've certainly seen significant improvements, but our testing bears out that Java still falls short of the comfort level corporate America is looking for.

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Yes, in some ways Java is a fast-moving technology, but about a year after we last examined Java environments, remarkably little has changed. The shipping products we tested in this roundup were all available in public beta last year. All have improved since then, but Java technology as a whole has not leapt forward.

A Java environment, also called a virtual machine (VM), is a computing platform—usually a software environment—installed on a host operating system to run Java applets and applications. For this story, we required that all environments support Sun's Java Development Kit (JDK), Version 1.1. This yielded

Java environments from 6 different vendors on 5 different operating systems, for a total of 18 configurations. Two Linux-based environments also qualified: a Netscape prerelease version and the JDK 1.1.3 ported by Blackdown Consulting. Neither, however, was able to complete our tests.

As was the case last year, our testing showed that Java still has quite a way to go before its promises are fulfilled. Performance continues to be slow, and compatibility is erratic across platforms. Also, compared with the content available for other platforms, there are few functional real-world Java programs to choose from. Our benchmark tests proved the Windows-based

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environments to be the fastest and most compatible with Java, outperforming Sun's own VMs by a considerable margin.

COMPATIBILITY IMPROVES

When you talk about Java compatibility, you're generally talking about compatibil-

ity with Sun's specification. But we also ran our own compatibility tests of 12 publicly available business-oriented Java applets. (Last year we tested 3 applets.) More than half of our test runs failed last year. Although this year's testing demonstrated a substantial improvement, 36 percent of

the test runs failed; some programs loaded but displayed inexplicable anomalies. (See the illustration below for some examples.)

The high instance of incompatibility isn't really much of a mystery, though. Within Java's short life span, the language has become large and complex, with multiple methods available to accomplish identical tasks. For example, a programmer can choose from among four or more sets of APIs for writing UI code that work on different sets of Java platforms: the

Cross-Platform Realities

Although Java compatibility has improved since last year, the promise of a "write once, run anywhere" world still feels a long way off. Our compatibility tests revealed a slew of anomalies that ranged from the merely annoying to the outright crippling.

Although Netscape ran DART Mail smoothly under Windows 95, the Symantec VM on Hot Java failed to size the options dialog box correctly.

The Apple MRJ on IE4 displayed the Equis MetaStock interface flawlessly. But the Microsoft VM for the Mac showed the top row of buttons overlapping the title bar.

Under Netscape Communicator, Netmosphere ActionPlan displayed the log-on box correctly on Windows 95. But on Windows NT the text disappeared. On IE4 for the Mac, the box came up blank.

Although Netscape under Windows 95 managed to run Lotus eSuite, you can see that JDK 1.1.5 on Hot Java had problems under Solaris. In this screen it lost an entire text box.

original AWT (Abstract Window Toolkit), the new AWT with enhancements in JDK 1.1, Personal AWT in Personal Java, and the upcoming Java Foundation Classes (JFC) plus SwingSet, planned for JDK 1.2. (For a preview of JDK 1.2, see "Java's Bright Future?")

Another important factor concerns licensees. When they port the Java environment to their platforms, they make changes to the VMs. Some changes are needed to get Java to work correctly, while others are optimizations. Because the APIs are complex (in that they define a large number of complex operations), they are easily thrown off by such changes, which in turn can cause compatibility problems.

JIT SPEEDS JAVA

Java performance is also a complicated issue. Our testing uncovered substantial deviations in speed among the environments. This year, the gaps were not as wide as in the past, but that is only partly due to improvements in the VMs. By testing only JDK 1.1 environments, we weeded out many of the slower, less stable, and less compatible implementations—most notably, those running under Windows 3.1. To date, there is no JDK 1.1-compliant version of Java for Windows 3.1, and to our knowledge none is in development.

Even so, we've seen many advances on the performance front this year, mostly in the area of *just-in-time compilers* (JITs). Normally, a Java VM takes compiled Java code—in a form called *byte code*—and interprets it byte by byte, executing the appropriate native instructions. A JIT intercepts this process at the method invocation stage. (A method is a subroutine much like a function or procedure in a non-object-oriented language.) Before Java executes the method, the JIT translates it or compiles it into native code. The JIT then caches the native code so a compilation won't have to be performed each time the method is invoked.

At first glance, it seems that even JIT-

Editors' Choice

• Microsoft JVM for Windows



Although a number of the JDK 1.1 implementations show promise, nearly all were unable to deliver both good speed and high compatibility. For instance,

OS/2 Warp showed impressive speed, but it could run only four applets fully. And although the Netscape VM for Solaris ran all but one applet, it failed to complete our benchmark tests.

The Microsoft Java Virtual Machine (JVM) for Windows was the exception, and it earns our Editors' Choice. For the second year in a row, Microsoft has produced the fastest and most reliable Java implementation available.

The Microsoft environment outpaced the competition across all of our JMark 2.0 benchmark tests. It boasted the highest scores on the Processor test under both Windows 95 and NT. Most notably, it dominated the AWT graphics test, on which its score was almost three times as fast as its closest competitor, the JDK

1.1.5 on Solaris. The Microsoft JVM for Windows was similarly commanding on our Text test, especially under Windows NT, where its score was more than twice that of JDK 1.1.5 on Solaris. On the whole, the Microsoft VM under Windows NT outperformed that under Windows 95, but by only a slim margin in most cases.

The Microsoft Java environment came close to a perfect score on our compatibility tests, where it ran all but one applet each on Microsoft Windows 95 and NT.

Although our tests showed that the compatibility rate for VMs running on Windows is a platform-leading 70 percent—and is almost 20 percentage points better than VMs running under Solaris—Java still has a way to go before we can say it runs dependably across platforms.

enabled Java could never outrun native code, and we think this is probably true. After all, the same instructions must be executed within each type of code, and native programs don't have the overhead of JIT compilation, in terms of processing time and extra memory consumption.

Because Java programs defer many decisions until runtime that other languages make at compile time, it's hard to compile Java natively. For instance, the reflection feature of JDK 1.1 lets an object learn about the fields and methods of other objects at runtime. Normally, the object information that makes this possible at runtime is stripped out of a natively

compiled program. But natively compiled Java has to build all this information into the executable, producing an overhead other languages lack.

Nonetheless, JITs have some performance advantages over native code. Unlike other languages, Java JITs are able to observe and act on information concerning the runtime environment. For instance, a JIT can observe that it is running on an MMX-enabled processor and use the MMX instructions where appropriate. Or it can observe that certain high-overhead operations, such as virtual calls, can be made in a more efficient way. And garbage collection—a program's ability to manage memory automatically—is done more efficiently in JIT-enabled code because most modern JITs are tied in extensively with the garbage collector. This helps ensure that registers are full and point only to valid data.

We put these theoretical cases to the

Our Contributors: LARRY SELTZER is technical director of ZD Virtual Labs. MARK VAN NAME is vice president of testing at Ziff-Davis. BILL CATCHINGS is director of product testing at Ziff-Davis Benchmark Operation, a research and development division of Ziff-Davis. RICHARD V. DRAGAN is a programmer at PC Magazine Labs. JOHN GARRIS is a frequent contributor to *PC Magazine*. KRISTINA DENIKE was the project leader, and TONI F. KISTNER was the associate editor in charge of this story.

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ZD Labs Roll Out JMark 2.0

With this issue's cover story, PC Labs introduces JMark 2.0, the new version of its Java benchmark test program. JMark 2.0 demonstrates Ziff-Davis's continuing commitment to improving the state of the art of Java benchmark tests and represents a significant developmental effort. (You can find JMark at www.virtual-labs.com.) You're free to quote the benchmark program's results, provided that you abide by the terms of its license agreement.

Larry Seltzer and Rich Dragan of PC Labs did the bulk of the work on the initial JMark tests, and the Ziff-Davis Benchmark Operation (ZDBOp) worked with PC Labs to develop this version and is already preparing future enhancements. Unlike the previous version, JMark 2.0 requires JDK 1.1. Choosing to leave JDK 1.0 platforms behind was difficult, but the improved features and anticipated prominence of the new version of JDK made the transition necessary. By the time you read this, JDK 1.1 should be widely available.

Most of the Java programs in use

today are applets, so JMark 2.0 also runs as an applet and not as a standalone application. Consequently, you need a browser or an applet viewer to try it out.

JMark 2.0 is made up of two primary tests—the Processor test and the AWT playback test—and a number of secondary inspection tests. The Processor test exercises not just the processor itself but the entire processor subsystem, including the cache, bus, and memory. In addition, this test helps illustrate the efficiency of the byte-code interpreter of the given Java environment. The new test is significantly larger than the processor test in JMark 1.0 and therefore better represents Java as it moves from simple applets to truly useful business applications. The Processor test also leverages what we've learned in developing processor tests for other platforms and environments.

The AWT test uses ZD-proprietary *playback* technology to demonstrate the graphics activity of Java applets and applications. It plays back the previously recorded AWT activities of three Java applets—a benchmark test results viewer, an interactive price/per-

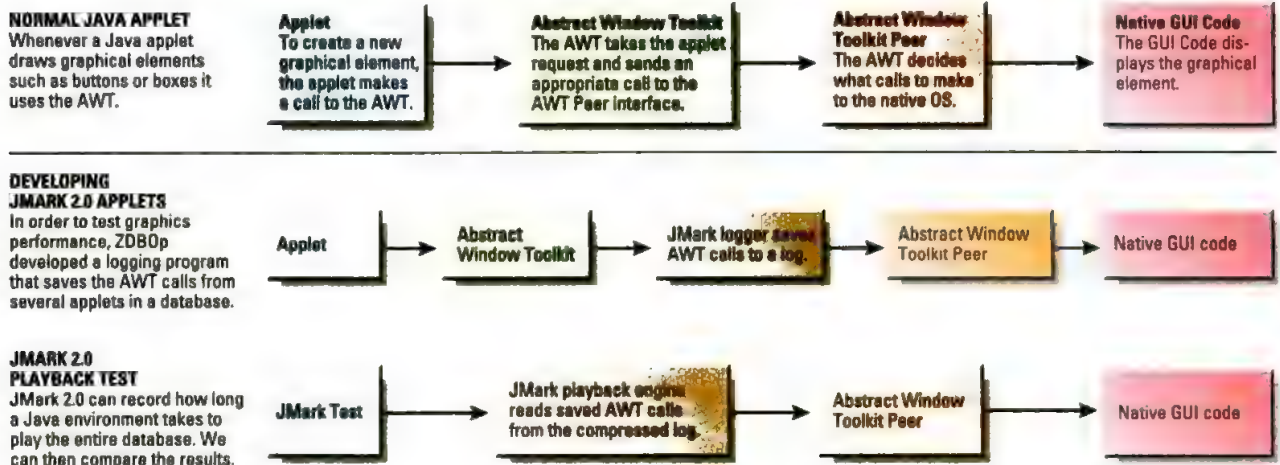
formance chart, and an interactive features table. JMark 2.0 also includes a number of inspection tests that examine such JVM performance attributes as graphics and threads. And we replaced some JMark 1.0 tests with improved ones and removed tests that no longer met our criteria.

Because we strive to produce the most accurate and repeatable test results possible, variability in test results was a major concern during JMark 2.0's development. We expect our test results on a given configuration to vary by less than 5 percent. To minimize variations even further, we run each benchmark test multiple times, rebooting the system between runs. The reliability of the benchmark tests was also of concern. The immaturity of the JDK 1.1 environments, many of which were in beta during our tests' development, hampered our efforts. We expect that as Java environments mature and vendors release patches, their reliability—and thus JMark 2.0's reliability—will improve.—Mark L. Van Name and Bill Catchings

How JMark 2.0 Plays Back AWT Activity

To build the JMark 2.0 AWT (Abstract Window Toolkit) playback test, ZDBOp developers began by writing a logging program. This logger captures all of the AWT activity an applet requests at the AWT Peer level, and then saves that information to its log. When you run the

JMark 2.0 AWT playback test, JMark 2.0 reads the same requests from the compressed log and passes them directly to the AWT Peer level of Java. This way, JMark is able to display exactly what the original applet displays on-screen.





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BENCHMARK TESTS

Java Environments



Again this year, JIT-enabled environments outperformed those without JITs. The Microsoft VM led the pack in overall speed and, most dramatically, in graphics rendering.

What the Numbers Mean

Because Java code doesn't run the same way across all configurations, the more a VM can do to optimize an applet's performance the better. Our JMark 2.0 tests showed that Java environments exhibit a wide range of speed, with some JIT-enabled VMs running up to ten times as fast as those without JITs in some cases. The clear winner was the Microsoft VM for Windows, which delivered the best speed overall and was over three times as fast at rendering graphics as its closest competitor.

JMark 2.0 comprises two main tests, the Processor test and the AWT (Abstract Window Toolkit) test. These are a mix of operations that, analyzed together, provide an accurate indication of an environment's speed. We also included some minor inspection tests to help pinpoint specific performance issues, such as how well the environment renders lines, ovals, and text, as well as its speed in processing calculations. (For more details on JMark 2.0, see the sidebar "ZDLabs Rolls Out the JMark 2.0 Benchmark.")

During our initial testing, the Microsoft VM for Windows was unable to display the full contents of the AWT test. After some

debugging and consultation with Microsoft, we determined that the AWT event queue in the Microsoft VM was being *starved*: In other words, the VM was prevented from dispatching events to the AWT queue because so much other work was being performed in the thread designated to perform AWT operations.

To remedy this, we altered the benchmark test to perform all AWT operations in a separate thread. When we reran the Microsoft VM for Windows, it displayed the benchmark test content completely, with no effect on the score. We then ran this new version of the test on the other environments and confirmed that our new approach did not affect their scores, either. It is not immediately clear whether event-queue starvation is a bug, though the behavior is obviously undesirable.

In the Microsoft VM for Macintosh, we uncovered a substantial bug: It reported benchmark test scores in powers of 2 (256, 512, 1,024, and so on). To achieve accurate scores, we first cast the value to an int (a 32-bit integer value), then to a double. Microsoft plans to remedy the problem in an interim release, which may be available by press time.

Two VMs failed to run all or part of our tests: the Netscape VM for Solaris and the Blackdown Consulting port for Linux (www.blackdown.org). Although Netscape did well on our compatibility tests, it was unable to complete the benchmark tests. And although last year we tested JDK 1.0 on the Linux platform, this year we were unable to get JDK 1.1 to run correctly.

With a command set large enough to spill out of the processor's L1 cache, the **Processor** test evaluates how fast the Java engine exercises the processor and memory. Our tests demonstrate that a JIT significantly improves performance, especially with calculation-intensive operations. The five configurations that lacked JITs were considerably slower on the Processor test than the average JIT-enabled environment, frequently delivering one-tenth the performance.

MAC OS 8	JIT	Processor	AWT	Complex Arithmetic	Fast Fourier	Threads
Microsoft Internet Explorer 4.0	Yes	200	N/A	418	173	N/A
MRJ 2.0 ¹	Yes	167	N/A	234	89	234
MICROSOFT WINDOWS 95						
Microsoft Internet Explorer 4.0	Yes	509	1,698	473	479	343
Netscape Communicator 4.04	Yes	437	347	343	488	341
Sun JDK 1.1.5 ²	No	32	179	204	25	112
Sun JDK 1.1.5 and Win32 Performance Pack ²	Yes	334	276	545	372	337
Symantec Visual Café for Java 2.1 ²	Yes	366	279	542	494	678
MICROSOFT WINDOWS NT 4.0						
Microsoft Internet Explorer 4.0	Yes	505	1,715	482	483	359
Netscape Communicator 4.04	Yes	435	383	352	492	358
Sun JDK 1.1.5 ²	No	32	304	205	25	112
Sun JDK 1.1.5 and Win32 Performance Pack ²	Yes	338	303	538	377	354
Symantec Visual Café for Java 2.1 ²	Yes	384	474	555	499	737
OS/2 WARP 4.0						
IBM Java 1.1.4 for Warp ³	Yes	232	N/A	609	402	340
SOLARIS 2.6						
Microsoft Internet Explorer 4.0 Preview	No	12	470	72	10	61
Netscape Communicator 4.04	No	N/A	N/A	N/A	N/A	N/A
Sun JDK 1.1.3 ²	Yes	206	503	402	130	301
Sun JDK 1.1.5 ²	No	33	584	200	17	108
Sun JDK 1.1.5 and Native Threads Pack ²	No	32	422	197	18	112
		BETTER ►	BETTER ►	BETTER ►	BETTER ►	BETTER ►

N/A—Not applicable. The VM could not complete this test. (1) Tested under Microsoft Internet Explorer 4.0 (2) Tested under HotJava 1.1 (3) Tested under Netscape Navigator 2.02

Our most demanding JMark 2.0 test is the AWT (Abstract Window Toolkit test), which evaluates how quickly a VM renders graphics and text to the screen. Once we added a separate thread for the graphics calls, the Microsoft VM for Windows 95 outran the other environments by almost 3 to 1. The Apple MRJ completed the test but failed to draw the complete image; the Microsoft VM for Macintosh and IBM OS/2 Java crashed consistently.

The **Complex Arithmetic** test evaluates the way Java breaks complex calculations into parts. Environments with JITs were two to three times as fast as those that lacked JITs.

The **Fast Fourier** test evaluates how fast VMs perform matrix transformations. The results mirrored those of the Processor test, with JIT-less VMs turning in markedly slower scores.

The **Threads** test evaluates how well environments handle multiple threads. Here, too, JIT-enabled VMs had the advantage. Symantec Visual Café returned scores roughly twice as fast as the Microsoft VM under Windows. The Microsoft VM for Macintosh appeared to run the test, but it returned no score. Because the Mac operating system doesn't support multithreading, Mac VMs must provide their own software thread libraries to run the test.

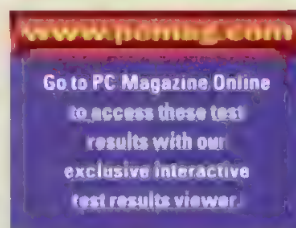
The **Stack** test exercises Java's standard implementation of the "last-in, first-out" structure commonly used in programming. OS/2, Virtual Café, and the Microsoft VM exhibited the fastest implementations.

JMark 2.0's graphic inspection tests call specific shapes to the VM, both as outlines and as filled shapes. We include three of the six tests here: **Lines**, **Round Rectangles**, and **Ovals**. (The results of the tests we omitted—Polygons, Arcs, and Rectangles—were similar to these.) The Microsoft VM for Solaris prerelease performed poorly on many of the tests. We hope Microsoft improves the basic graphics calls before it releases the final product.

The **Text** test demonstrates how well the applets display a wide

variety of formatted text. An environment that did well on the AWT test generally fared well here, too. The Microsoft VM for Windows led the pack by a wide margin, but the Sun JDK 1.1.3 also did well, with double the speed of the JDK 1.1.5.

The **Graphics Threads** test uses the same threading support as the Threads test but spawns multiple windows displaying graphics. Although JDK 1.1 doesn't utilize Solaris's built-in support for threads, it does use the built-in threading support in Windows. As a result, the environments running under the Windows NT platform performed twice as fast as the others, a big step up from last year's showing. The Solaris Native Threads Pack did not improve performance over the JDK 1.1.5.—*Analysis written by Kristina DeNike*



How We Tested

All JMark scores are relative to the speed of a Pentium/100 machine running Windows 95 and Netscape 4.0, whose score is defined as 100. The graphics tests were performed with the graphics accelerators set to 8-bit color.

For testing the Windows and OS/2 environments, we used a Dell OptiPlex GXa with a 300-MHz Pentium II processor and 64MB of RAM, and ATI's Xpert@Work graphics accelerator.

For the Macintosh environments, we used a 266-MHz Power Macintosh G3 processor with 96MB of RAM. We set the partition size for Internet Explorer at 20MB. The Power Mac includes an ATI graphics board.

For the Sun environments, we used a 296-MHz Sun Ultra 30 processor with 182MB of RAM. The Ultra includes a Sun Creator 3D graphics accelerator.

Stack	Lines	Round Rectangles	Ovals	Text	Graphics Threads
270	186	238	188	164	N/A
143	67	115	99	127	111
972	183	178	124	1212	189
351	209	188	132	375	179
105	179	228	144	315	141
485	337	185	146	553	154
1014	202	237	144	621	165
978	400	360	345	2807	312
339	771	427	396	383	414
106	519	469	412	369	402
511	630	484	418	686	504
1,076	716	507	433	752	556
1,347	258	57	56	298	56
95	65	5	120	674	12
N/A	N/A	N/A	N/A	N/A	N/A
334	314	515	636	1172	265
118	376	504	645	435	157
115	273	514	616	413	231

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test to see whether JIT-enabled Java code could outperform native code. First, we used Symantec Visual Café for Java to compile four of the inspection tests in our JMark 2.0 benchmark test program into Win32/x86 code natively. Then we compared this performance to that of the fastest browser on those tests, Microsoft Internet Explorer 4.0. IE4 was faster on three of the tests, and there was little difference on the fourth. After talking to Symantec and considering other test results, it appears that native compilation of Java is still in an early, immature stage. In another informal test, we compared the performance of a program written in parallel Java and native C++ versions. Based on the results, native C++ code clearly still has a performance edge over JIT-enabled Java.

This story marks the debut of Version 2.0 of JMark, our benchmark program designed to test the performance of a Java environment. See the sidebar "ZD Labs Rolls Out JMark 2.0" for further details on our new benchmark test program and how you can use JMark 2.0 to test your own Java environments.

OS/2 Warp 4.0

IBM's commitment to bringing Java to all its platforms—including 390 mainframes, AS/400, and AIX—is reflected in its Java 1.1 environment. The speed of OS/2 Warp 4.0 was good, even outpacing the Windows environments on the Processor test. But a complicated installation, below-average compatibility, and a lack of platform-developer support leave much room for improvement.

A notable limitation to the OS/2 environment is that it runs only from Netscape's Navigator 2.02 browser, which lags two full versions behind its cousins. As of this writing, the vendor had no plans to update the browser before year's end. The best hope for OS/2-based upgrades will come from third parties building on Netscape's public release of source code for Communicator 5.

Configuring JDK 1.1 on OS/2 took considerable effort. OS/2 includes the older, JDK 1.02 environment. Upgrading to JDK 1.1 required us to download separate files for the environment and the browser. The environment required a 28MB file download from the IBM site,

and the browser required a patch for JDK 1.1 support to be downloaded from the Netscape site.

Once installed, the OS/2 VM delivered respectable scores on our JMark 2.0 tests. Most notably, it outranked all the non-Windows platforms on the Processor test. Though trailing on the graphics tests and slow on the Graphics Threads tests, it produced the highest scores on the Complex Arithmetic, Stack, and Vector tests.

OS/2 didn't fare nearly as well on our compatibility tests. It landed near the end of the pack, running only 4 of the 12 applets successfully. Since IBM owns Lotus, it was surprising that the OS/2 environment failed to run the Lotus eSuite Sales Forecast or Sales Presentation applets. Neither was unable to draw the screens correctly.—*Rich Dragan*

Macintosh OS 8

Macintosh users will feel like second-class citizens in the world of Java. In terms of performance and compatibility, these environments can't compete with the Windows and Solaris platforms. Nevertheless, Macintosh VMs have their good points. We were impressed with Apple's administration tool, JManager, which made easy work of configuring the environments. And on our tests, simple applets ran smoothly.

There are two JDK 1.1 compliant environments for Macintosh: Apple's Mac OS Runtime for Java (MRJ) 2.0 and Microsoft's Virtual Machine in Internet Explorer 4.0. Although a Macintosh VM for Netscape Communicator was also available, it wasn't JDK 1.1-compliant.

Aside from facilitating an easy install, the JManager tool let us swap Java environments seamlessly within IE 4.0 with one change to the Preferences settings.

Of the two, we found the IE 4.0 environment substantially faster than the Apple MRJ. Although both Apple and Microsoft use JIT compilation to speed their runtime environments, IE 4.0 performed about twice as fast as MRJ on most of our tests. Compared with the Solaris and Windows environments, the Macintosh VMs were quite slow and unstable: Their Processor scores came in last among JIT-enabled environments.

The Macintosh VMs exhibited poor compatibility when running complex applets. We experienced a wide variety of

errors on our tests, including "java.lang.VerifyError" dialog boxes, out-of-memory errors, and blank screens. For example, loading the HotSheet applet under IE 4.0 locked up our system, forcing us to reboot manually. And loading the HotSheet applet under MRJ 2.0 caused only a blank rectangle to display.

It is worth noting that Java developers are partly responsible for the Macintosh's compatibility woes. For example, Lotus admits that, though supporting its eSuite applets under Windows 95 and Windows NT, it hasn't completed testing on the Macintosh platform. Therefore, we weren't surprised to find that running eSuite caused problems—out-of-memory errors with IE 4.0 and Illegal Access errors with MRJ. The lack of Macintosh testing not only caused errors but also produced user-interface anomalies. For instance, while running Equis's MetaStock applet, the Macintosh's pop-up menus displayed large enough to overlap portions of the surrounding text boxes.—*John Garriss*

Microsoft Windows 95/Windows NT



Never mind what's going on in the press: Microsoft is apparently taking no chances with Java. For the second year in a row, its Java environment was the fastest and most compatible on our tests.

And it wins our Editors' Choice.

Microsoft primarily distributes its Java VM as part of Internet Explorer 4.0 (recently updated to 4.01). The VM (plus extra libraries) is also included in the Microsoft Software Development Kit for Java (SDKJ). Unlike the Netscape VM, the Microsoft VM for Java (Windows version) can run both applets and applications.

Our testing showed that Microsoft's Java environment is clearly the fastest, with Windows NT slightly outpacing Windows 95. On both, IE 4.0 was 16 percent faster on the Processor test than its closest competitor, Netscape Communicator, and 3 and a half times as fast as the Symantec VM on the AWT playback test. As was the case last year, Windows NT was much faster than Windows 95 with AWT operations.

Microsoft's environment under both platforms turned in a compatibility suc-

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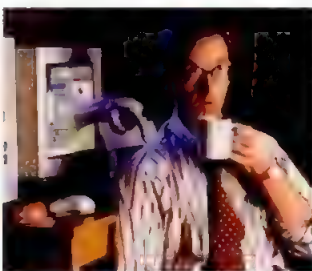
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PERFORMANCE TESTS

Compatibility



The performance of a Java environment is important. But if it can't run the applets you want to use, speed doesn't matter.

How We Tested

To test the compatibility of Java applets with Java environments, we tested 12 applets against each configuration. Because nearly all of the configurations were created with JDK 1.0 (and the environments were created with JDK 1.1), we were able to gauge the VMs' real-world compatibility as well as backward and forward compatibility. Although all the applets we downloaded from the Internet (except Employee Payroll) are 100% Pure Java-certified, no single environment was able to run every program successfully.

As was the case last year, the Windows environments delivered

the best compatibility scores, this year running 70 percent of the applets correctly (counting partially successful tests). But this score may more accurately reflect the amount of time and effort vendors spend testing their programs on Windows platforms rather than any qualitative improvement in the VMs themselves. (For example, Lotus admits that it optimized eSuite for Windows environments.) The Solaris environment exhibited poor compatibility, running only 53 percent of the applets. OS/2 and Macintosh fared even worse, running only 33 and 25 percent of the applets, respectively.

Across all environments, the success rate for Java applets was 64 percent. This score is considerably higher than last year's 41 percent (50 percent on Windows), but there's still substantial room for improvement.

Testing for compatibility raises some ambiguities: When is an observed error a compatibility problem and when is it a software bug? To some extent, it's impossible to tell. What appears to be an incompatibility with the environment may be the result of the program not working with the VM properly.

The chart below indicates which environments loaded the indicated software correctly. We deemed the test unsuccessful in cases when, on loading the applet, we experienced system locks or application errors that rendered the application non-functional. An applet received a partial pass if it ran most of

▲ Pass ◆ Partial ● Fail

Platform	Macintosh OS 8		OS/2 Warp 4.0	Solaris 2.5					
Environment	Apple MRJ 2.0	IE 4.0	IBM JDK for Warp	JDK 1.1.5	JDK 1.1.3	IE 4.0 (beta)	NS 4.04		Native Threads 1.1.5
Browser	IE 4.0	IE 4.0	NS 2.02	HotJava 1.1	HotJava 1.1	IE 4.0 (beta)	NS 4.04		HotJava 1.1
Anyware Office									
Applix Inc.	●	●	●	▲	▲	●	▲		▲
DART Mail (demo)									
NetAccent Inc.	◆	●	▲	▲	▲	▲	▲		▲
Employee Payroll									
Software Engines Inc.	●	▲	●	▲	▲	●	▲		▲
eSuite Sales Forecast									
Lotus Technologies Inc.	●	●	●	●	●	●	●		●
eSuite Sales Presentation									
Lotus Technologies Inc.	●	●	●	●	●	●	●		●
InfoBook									
Divya Inc.	▲	▲	▲	▲	▲	▲	▲		▲
MetaStock									
Equis International	▲	▲	▲	▲	▲	●	▲		▲
NetCharts Pie Charts									
NetFactory Inc.	◆	◆	◆*	◆*	◆*	◆	▲		◆*
NetCharts Auto Scaling on the Y-axis									
NetFactory Inc.	◆	●	▲	▲	▲	▲	▲		▲
Netmosphere ActionPlan									
Netmosphere Inc.	●	●	●	●*	◆*	●	▲		●*
Netmosphere HotSheet									
Netmosphere Inc.	●	●	●	●*	◆*	●	▲		●*
TimeCruiser									
WebMan Technologies Inc.	▲	●	●	●	●	▲	▲		●

* This browser is incompatible with JavaScript. NS—Netscape.

cess rate of 70 percent; Windows 95 and Windows NT each failed to run only one applet. This score is almost 17 percent better than those of the Sun environments. As mentioned elsewhere, some (if not much) of Microsoft's success can be attributed to rigorous testing of the environment by Java program developers. It's also noteworthy that the Netscape VM under Solaris exhibited compatibility equal to that of the Microsoft VM.

IE 4.0's top performance and compatibility are ironic given Sun's lawsuit against Microsoft, in which the latter company is accused of altering Java to include Windows-specific features. Microsoft contests many of the charges leveled against it by Sun but not all of them. The vendor doesn't distribute two parts of the standard JDK—Remote Method Invocation (RMI) and Java Native Interface (JNI)—as part of IE4. Though it makes the RMI code

available on its Web site, this is much less convenient to access than if it were included as part of the VM. Java programs that implement RMI won't work on the Microsoft environment as shipped.

Microsoft simply doesn't support JNI. Since some standard Java facilities such as the JDBC-to-ODBC bridge rely on JNI, Microsoft uses its own Raw Native Interface (RNI) instead. Microsoft claims that JNI is slow and cumbersome, RNI is

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Pssst! Wanna Buy an NC?

If it's important for you to have the simplest client hardware and absolute control over your clients, you may want to consider moving your shop to *network computers* (NCs).

What exactly is an NC? Different vendors are throwing the term around loosely, using it to describe everything from Java-only terminals to full systems.

Because Java is central to the marketing of many NCs, we attempted to acquire some for testing. We didn't have much luck. Digital, Oracle (NCI), and Sun Microsystems all declined to send us one. In the end, we procured only two: the IBM Network Station Series 1000 and the NeoWare NeoStation. Last year, we reviewed a Sun JavaStation, but its new JDK 1.1-compliant NC wasn't ready in time for this roundup.

Although the NeoStation wasn't JDK 1.1-compliant, it serves as a good example of what's being marketed as an NC these days. The product is a standalone computer that boots a proprietary version of Unix off an internal hard disk. The processor is an Intel i960, usually found in embedded applications such as laser printers.

The IBM 1000 better represents the ideal NC. It is a JDK 1.1-compliant standalone terminal running a PowerPC 603e processor and has no hard disk. The machine boots from a server running IBM's Network Station Manager



The IBM 1000 was the only true NC we could get for testing.

Software, which is free. It is available for Windows NT as well as IBM AS/400, and RS6000 mainframes. The IBM 1000 isn't cheap, however. The unit with 32MB of RAM costs \$999; the unit we tested had 64MB of RAM, raising the cost to \$1,199.

IBM stresses that the IBM 1000 encompasses more than Java. It's targeted at heterogeneous enterprises with many types of servers. The box itself can run X applications on the server, Windows applications on Citrix Multi-user NT, host applications via 3270 and 5250 terminal access, and Java programs locally. It also includes Navio, a custom variant of Netscape Navigator that runs native on the IBM 1000.

was respectable, with a Processor score only 14 percent lower than that of IE 4.0.

At the time we tested, Netscape Communicator 4.04 for Windows shipped with only a partial implementation of JDK 1.1; to obtain the AWT enhancements, we needed to download a separate, publicly available patch. By the time we go to press, the full version should be available. But "full JDK 1.1" is a slight exaggeration, as Netscape doesn't claim to implement the entire spec and has withdrawn the "Java Compatible" logo from the browser. Though Communicator includes a custom version of the Symantec JIT,

testing revealed that the JIT is a slightly older version than the one in Symantec's Visual Café for Java (Windows version). The latest version should also be available when you read this.

Although most applets ran well under Communicator, there were a few inexplicable exceptions under Windows: The ActionPlan applet ran fine under Windows NT, but its log-on screen appeared consistently as a blank panel under Windows 95. Conversely, the eSuite applets ran well under Windows 95 but regularly locked up under Windows NT.

Netscape recently announced that

Configuring the IBM 1000 was difficult. Minor bugs and extensive configuration required almost a full day in our Labs for an IBM representative. But once configured, the IBM 1000 was appealing in many ways. Because all the client files and configuration information reside on the server and are administered through a Web browser, the IS professional can work from anywhere.

Java compatibility was poor, however. The IBM 1000 failed to run several of our test applications, so we couldn't run our planned performance test. Local execution seemed reasonable, though, in the context of Java performance on other systems.

This is the obvious question: Why should you get an NC? We're still not sure. A PC can do everything the IBM 1000 can, for less money. It can run X server software, run faster Java VMs, and host terminal programs as well as Windows programs both locally and on the server. You can configure PCs to boot from a network and manage them via a network operating system such as Windows NT Server. If you want complete control over your client PCs, you can remove all the mass storage and lock the case. You'll still have a fully functional computer that can run complicated applications locally, independent of the network. This raises another key point: If the network goes down, no one using an NC can work.—LS

starting with Communicator, Version 5, the browser-to-Java interface will conform to an open specification called Open Java API. This will let you plug third-party Java into Communicator, letting users run the latest version of the JDK. Netscape will continue to ship its own Java support with future versions, at least through Version 5.

SUN JDK 1.1

Sun's Java Development Kit (JDK) is the definitive version of Java. More than just a VM and standard libraries, the JDK is the standard development tool for the Java language.

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This being the case, it was somewhat surprising that we experienced more failures on compatibility tests under the JDK than under the Netscape or Microsoft environment, neither of which Sun considers compatible.

It wasn't surprising that the JDK, which lacks a JIT, was markedly slower than any other Windows Java environment on our Processor test. Sun's version of the Symantec JIT, the Java Performance Runtime for Windows, continues to be designated by Sun as an early-access version, though it first became available in the middle of 1997. Sun hasn't explained why it was never released.

We tested the Sun environments on HotJava, Sun's Java-based browser. Arguably, HotJava is the program that got everyone excited about Java, because it was the first to run on both Solaris and Windows. Despite its history, HotJava is being put out to pasture; the 1.1x generation will be the last. Sun plans to replace it with a new Java-based browser by Netscape, code-named The Javagator and expected to ship in the first half of 1998.

Replacing HotJava with a modern browser is probably wise. A lack of scripting support means that Web and intranet pages built in JavaScript won't display correctly, making it a weak solution for viewing applets—as our compatibility tests showed. In addition, HotJava's user interface is slow to react, and upon scrolling, the contents completely fall apart until

and avoid possible Microsoft and Netscape incompatibilities. But because Activator is used as a plug-in or ActiveX control, it cannot use standard APPLET tag syntax, which prevents you from running standard Web pages that call Java code. Although Sun provides a tool for modifying these tags, Activator is ineffective for running applets from the Internet, where you're not likely to encounter an Activator-ready page.

The only instance in which Activator might be useful is in environments that run a single Java implementation and multiple browsers, where users are willing to run completely proprietary HTML. But building such pages also adds a step to already complex intranet development. You can download the second, early-access release of the Activator through Sun's Java Developer's Connection (free membership required) at java.sun.com/jdc.

Clearly, Microsoft wants you to think of Java development as another means of accomplishing Windows development.

you release your mouse. Frame support and printing also frequently failed.

Sun also has a product called the Activator, which enables its Java environment to function as a plug-in within Netscape Communicator or as an ActiveX control within Microsoft IE 4.0. This lets enterprises that must support both browsers use a common Java VM

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with their products. Symantec also includes its VM and JIT with Visual Café for Java, and Visual Café developers can include the Symantec VM along with their applications.

To test the Symantec environment under HotJava, we set the HotJava JDK_HOME environment variable to the Visual Café Java directory. Symantec's performance results were surprisingly slow. It lagged behind Communicator on the Processor test— even though Netscape uses an older, slower version of the same JIT. Symantec produced much better AWT Playback numbers, though they were nearly one-fourth the speed of the leader, Microsoft IE 4.0. But the Symantec environment generally did quite well on our inspection tests.

The compatibility results weren't encouraging under Windows 95. The environment exhibited multiple errors, which included a mix of system lockups and less serious problems. Compatibility improved, however, under Windows NT to become roughly on a par with Netscape Communicator. —*Larry Seltzer*

Solaris 2.6

Solaris shops have two choices for running JDK 1.1: the Sun HotJava 1.1 browser or the Netscape VM that's part of Communicator 4.04. Although HotJava can run multiple JDK environments, Communicator's superior support for related Web technologies (such as JavaScript and frames) as



In compatibility testing, Netscape on Solaris

matched the Windows-based competition, running **every** applet except eSuite.

well as its top-tier compatibility make it the better option. We tested a beta version.

HotJava's advantage over the Netscape VM is its ability to let you upgrade to the latest version of the JDK by editing a few Unix variables within the environment, obviating the need to upgrade the browser as well. Using this feature, we tested HotJava under three configurations: JDK 1.1.3

(which shipped with Solaris 2.6), Sun's JDK 1.1.5 (the current release), and JDK 1.1.5 with Sun's Native Threads Pack (NTP).

In performance testing, the Netscape VM was unable to complete our JMark tests, perhaps due to its prerelease status. In our subjective testing, however, we found the environment to be quick and responsive.

The HotJava VMs lagged well behind the Windows environments in terms of speed. Of the three, the most impressive performance came from JDK 1.1.3, the only Solaris environment to include a JIT compiler. On the Processor test, JDK 1.1.3 scored six to seven times as fast as the non-JIT releases, and over two and a half times as fast on the Text test.

Although the two JDK 1.5 VMs we tested do not include a JIT, future releases of each will include one. According to Sun, SunSoft—a separate division of Sun—wrote its JIT specifically for the Solaris 2.6 release. Although Sun did not incorporate the SunSoft JIT into JDK releases after 1.1.3, it plans to incorporate parts of SunSoft's JIT code in the upcoming JDK 1.2.

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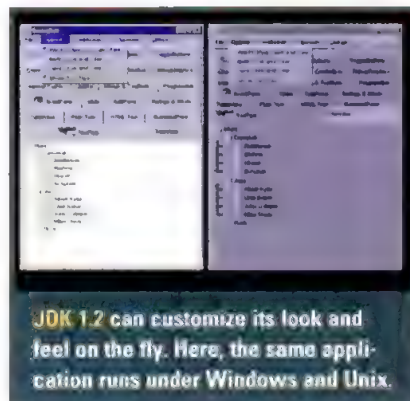
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Java's Bright Future?

Sun's JavaSoft software division is working on the next major upgrade to Java, JDK 1.2, due later this year. The company promises that the release will have a richer and considerably more scalable Java platform. A quick overview shows you what to expect from the Java of the near future.

Many of the planned improvements center around the new Java Foundation Classes (JFC) and the Swing user interface classes, which replace the more primitive Abstract Window Toolkit (AWT) classes of JDK 1.0/1.1. Using Swing will let programmers build much richer user interfaces in Java. Swing includes such components as tree controls, tables, and other highly graphical objects that will be standard fare in future browser versions. Because Swing adopts a sophisticated internal architecture, its components can adapt their look and feel to native OSs, so that the same component will look like a Windows 95 control in Windows and like a Macintosh control on a Mac, for instance.

JDK 1.2 gives Java applications the power to behave just like native apps in other ways, too. For example, it includes support for drag-and-drop operations. JDK 1.2 also includes a method for associating Java applets with particular types of Internet content, such as image or sound files,



as well as improved keyboard and event-handling support. JDK 1.2 will offer improved support for printing and graphics with the new Java 2D API classes. Users should also experience better multimedia, with new sound APIs that support .WAV, MIDI, and AU files.

Strides have also been made in the area of security. JDK 1.2's new security model will let users (and administrators) define policies that control the content a source can access using permissions. Security controls will be much more detailed than in earlier versions of the Java sandbox. The new version is also expected to provide support for certificates and will comply with the X.509 standard for authenticating content.

Overall performance should improve as well, at least for some tasks. Featured improvements will include

native support for threads under Solaris, faster garbage collection, and improved multitasking. In addition to JDK 1.2, Sunsoft will also offer HotSpot, a separate VM that promises to boost Java performance considerably.

JDK 1.2 will have plenty to offer developers, too. It will include a host of minor improvements (such as more robust support for JavaBeans, reflection, and serialization), as well as new areas of functionality. For example, JDK 1.2 will support more classes for built-in *containers* (data structures), which programmers commonly use to store objects. For accessing the interiors of Java environments, JDK 1.2 offers ways to interact with Java garbage collection and the JVM itself. It will also include enhancements to the Java Native Interface (JNI) as well as the notion of *extensions*, which allow Java designers to distribute Java and native code together where appropriate. JAR files—normally used to distribute Java code—will also get a boost, with better tools to create and sign them.

Although it appears that JDK 1.2 may finally fulfill the promise of Java, Sun does not promise full backward compatibility with JDK 1.0/1.1—compliant programs. For a list of incompatibilities under JDK 1.2, go to www.javasoft.com/products/jdk1.2/compatibility.html—Rich Dragan

Compared with other platforms, the HotJava configurations fared very well on the graphics tests. They were among the high scorers on the Lines, Round Rectangles, Ovals, and Text inspection tests. On the Processor test, HotJava 1.1.3 performed respectably, but the 1.1.5 configurations were quite slow. The Microsoft VM was 15 times as fast as the HotJava VMs overall.

In practice, the primary advantage of Sun's NTP is that it lets the JDK schedule threads across multiple CPUs. Employing NTP, the JDK schedules multiple threads at the Solaris kernel OS level rather than

within the Java environment itself. But our tests demonstrated almost no impact on performance, and the environment even suffered slightly on the graphics inspection tests. On server-based configurations, we noted a slight improvement. For those users running server-based Java applications, NTP is a good choice.

On our compatibility tests, Netscape on Solaris matched the Windows-based competition, running every applet except eSuite (which doesn't support the platform). But a number of applets using scroll bars each exhibited a runtime warning that the scroll bar increment was set to an improper value.

HotJava's compatibility scores were in the midrange. They were hampered primarily by the VM's inability to run applets built in JavaScript, such as ActionPlan and HotSheet, and those that use frames, such as eSuite.

We also tested a preview release of Microsoft Internet Explorer 4.0 for Solaris. We found it not yet ready for competition, though. The environment was unable to run most of the applets in our compatibility tests and appeared quite slow in our subjective performance evaluation. Expect the shipping version to become available by press time.—JG 

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JAVA

APPLET BY DREW ALWANG TOOLS

Java applets, tiny programs that you download and run in a browser, have the potential to transform a static Web page into an interactive experience.

New, easy-to-use Java applet tools make it possible for anyone to create Java applets such as animations and Web forms and add them to pages.

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As the Web becomes increasingly crowded and sites grow more sophisticated, it takes more to make your page stand out. By adding Java, you can create the sort of interactive experience that grabs attention. The Java applet tools reviewed here can be used by anyone because they require no coding. Instead, they let you combine existing Java components visually into applets and incorporate them into a standard HTML-based Web page.

Applets can be used simply to enhance the look of a page and lend it a little interactivity. For example, you can create animated sequences that change as a visitor moves over different areas of your page or

presses buttons. But you can also use them to build forms or create links from your page to a database.

Although none of these programs require Java proficiency, they vary in difficulty. Astound WebMotion and Lotus BeanMachine for Java are as easy to use as a business presentation package such as Microsoft PowerPoint. Others, such as Kinetix's Hyperwire, Interleaf's Jamba, and Sun Microsystems' Java Studio, tend to be a little more difficult and are geared more toward Web design professionals. Prices range from \$20 (street) for a basic program, such as NEC Systems Laboratory's AuraLine Multimedia Creation Kit, to \$250 (street) for the more advanced Hyperwire.

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Our interactive version See more demonstrations of Java technology online at PC Magazine's Web site. You'll find narrated walk-throughs of products, interactive features tables, and a place where you can tell us what you think about the reviewed products.

Don't confuse these tools with true Java development tools. Although higher-end packages also include visual tools, they are designed for programmers who build enterprise applications. Developer tools can also be used to create Java components, or JavaBeans, from scratch.

Java applet tools, on the other hand, rely largely on prebuilt components. Each of these seven packages includes a library of components ranging from basic animations and buttons to data panels and 3-D viewers. To extend these tools, you can download additional Java components

from vendor Web sites or from popular Java applet resources on the Web.

Since we first looked at Java applet tools ("Java: Create Your Own Applets," June 10, 1997), Sun has released a new version of its Java Development Kit (JDK) that offers better database connectivity, significant performance enhancements, and the long-awaited implementation of JavaBeans. Only two products in this story, Java Studio and BeanMachine, currently take advantage of JDK 1.1.

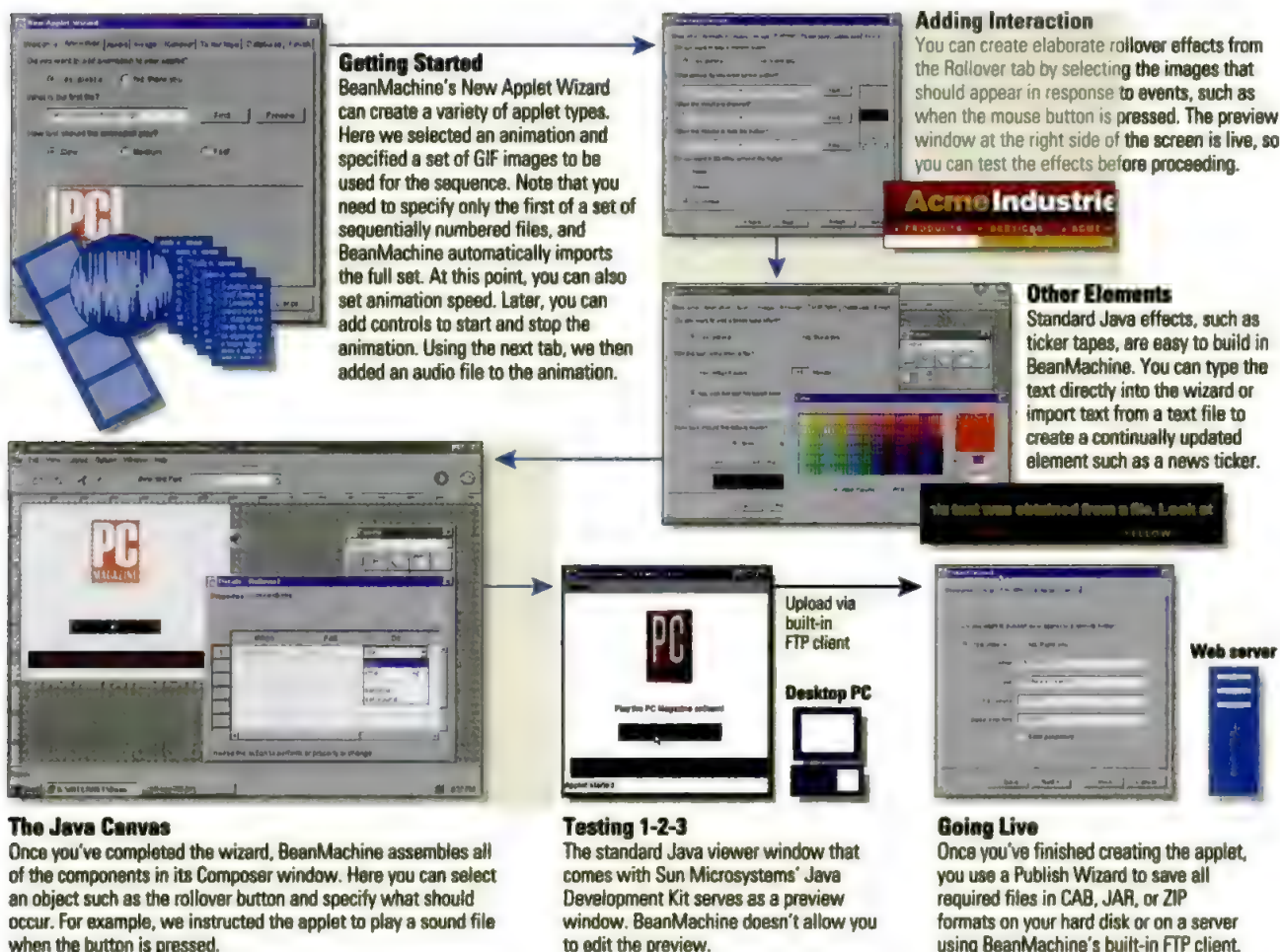
Now that this product category has had some time to mature (a year is a long

time on the Internet), we've noticed several trends. First, these tools have become significantly easier to use thanks in part to new wizards. Second, they are becoming more powerful, especially with the addition of JDK 1.1.

Finally, the tools are generally split into two camps. On one side are tools for Web designers and others who want to create slick animations or interactive elements for jazzing up Web sites. Two examples are WebMotion and Jamba. In the opposite camp are products geared toward more data-intensive tasks such as e-mail forms, guest books, database connectivity, counters, and so on. Although this latter category is typically used in business settings, both types of applets can be used on either personal or business Web sites. And the

Building a Java Applet

Using one of today's better Java applet tools, you can start creating an applet by simply working your way through a wizard. In this example, we used Lotus BeanMachine for Java to build and publish a simple animation in about 15 minutes.



best products offer some tools for creating both types of applets.

Although these products vary in their approach to building applets, the basic process is the same in most cases. To get started, you typically import the graphics and other files you're planning to use and place them in a predefined applet workspace. You can then add transition effects such as fades, dissolves, and wipes to images. The better programs include wizards that let you select the type of applet you want to create and then walk you through the process of assembling the pieces.

The next step is to add interactivity using what the object-oriented programming world calls *events*. An event can be a simple mouse click or an occurrence that is related to another object, such as the completion of an animated sequence. Each event triggers a corresponding *action*, which can be anything from starting a new animation to jumping to another Web page.

In some cases, the method used to define events is highly visual. Both Hyperwire and Java Studio, for instance, represent the connections between objects symbolically. For example, you can draw a connection representing a "click" event from a button to an image's "start" action to indicate that when the button is clicked, the animation should begin. Other products, such as BeanMachine, let you pick events and actions from a drop-down list.

Once you create the applet, you can preview it either within the program or in a Web browser. If everything seems to be working fine, you're ready to publish it to a Web page. This process entails compiling the Java code, packaging it in a format that a browser can read, copying it to your Web server, and including the HTML tags in your Web page to call or invoke the applet. Fortunately, most of these tools have publishing wizards to simplify these chores.

Applets can be published as straight Java class files (collections of Java programs) or using compressed formats including CAB (cabinet) files used by Microsoft Internet Explorer (IE) and ZIP files used by Netscape Navigator. Only BeanMachine and Java Studio support the newer Java Archive (JAR) format, which

Editors' Choice

- Multimedia design: Jamba 2.1
- General use: Lotus BeanMachine for Java 1.1



The tool you should choose for adding Java to your Web pages depends on the types of applets you want to create and the amount of time you're willing to

invest in learning a new tool. Our two Editors' Choice recipients reflect these considerations.

Both Interleaf's Jamba 2.1 and Lotus BeanMachine for Java 1.1 include wizards that help you build basic applets you can then further customize. Beyond that, the two products serve different purposes. Jamba is a powerful tool for creating Java animation, but it is slightly more difficult to use and geared toward design professionals. BeanMachine allows you to create a wide variety of applets, from basic animations to database connections, and is exceptionally easy to use.

Jamba's powerful animation features are what separate it from the

pack. You can assign variables, expressions, and conditions to animation objects. The bundled Jamba Animator lets you create both timeline- and path-based animations and control layers, zooms, fades, multiple image paths, and loops. Jamba also includes its own powerful image editor.

BeanMachine's wizards walk you through the whole process, from creating a new applet to publishing it on a Web site. Despite the product's simplicity, it is a surprisingly powerful tool. BeanMachine can create applets that connect to any ODBC-compliant or DB/2 database; its Bean Wizard allows you to import new Beans or Java classes to extend the program, and it supports the widest types of publishing options.

can be read only by the latest versions of IE and Navigator. Compressed formats are critical, because the size of the file affects the download time. Several programs require "player" classes ranging from 20K to 180K that must be downloaded in order to run the applet. There are several methods of transferring applets to your Web server, from automatic FTP transfers to copying files manually.

During testing, our results varied. We were impressed, however, with ability of these programs to create and publish eye-catching applets with surprisingly little effort. The key is to choose the product most closely tailored to the types of applets you want to create and to your level of experience. Our story will help you to locate the product that can keep people coming back to your site for more.

Astound Inc.

Astound WebMotion

A focused Java authoring tool, Astound WebMotion 1.02 (\$50 street) is designed primarily for the task of creating animated applets and animated GIFs. Other tools, such as Sun Microsystems' Java Studio and Lotus BeanMachine for Java, are better suited for creating forms and connecting to databases. And although WebMotion falls short of the animation power in Interleaf's Jamba, it will nevertheless appeal to those looking for a simple tool for creating interactive animation.

WebMotion employs a moviemaking metaphor. To build an animated sequence, you place "actors" (images) on a stage and specify paths for the actors to follow. The interface consists of a stage, where you build the animation; an animation toolbox; and a score window in which you edit the sequence. When you start an animation, a wizard walks you through selecting a stage

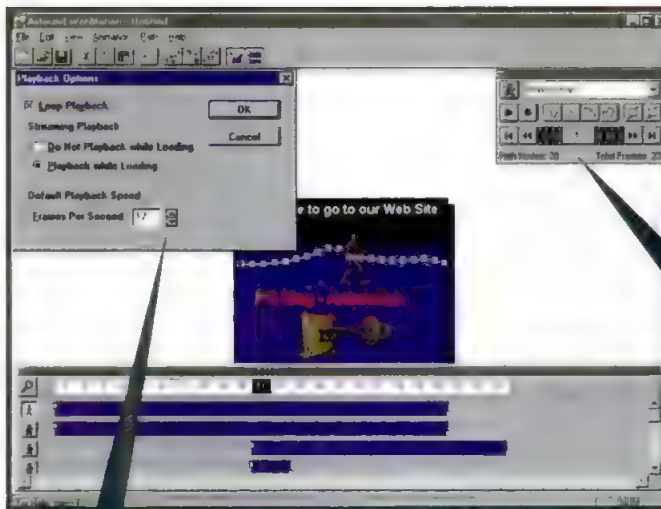
Our Contributors: GREG ALWANG and EDWARD MENDELSON are contributing editors of *PC Magazine*. DIANE JECKER was the project leader, and JOHN MORRIS was the associate editor in charge of this story.

size, a background image or color gradient, actors, and paths.

Actors represent one or more animation *cels* (the individual frames that create an animation when played in a sequence) and are added using the Add Actor Wizard. Actor images can come from an existing WebMotion Actor file, an imported image, or text you enter. As you import a series of images, WebMotion lets you preview the animated actor and edit the order of the cels. Any actor can be rotated, resized, or flipped horizontally or vertically. You can also control the transparency of each cel.

Like Jamba, WebMotion supports a variety of paths, including free-form paths, straight lines, curves, and polylines. You control the speed of the actor image in frames per second, as well as the looping, direction, and sequencing (the ability to play an animation forward, then backward, then forward, and so on) of each path.

Once you've defined the actors and



ASTOUND WEBMOTION gives you control over image paths as well as playback speed and looping.

paths, you can add interactivity using events triggered by either single- or double-clicking the mouse. Events include

linking to a URL, jumping to another frame in the animation, playing an audio file, and pausing or changing the speed of the animation. You cannot, however, trigger other Java events or call other applets as you can with Jamba. In addition, WebMotion provides no standard objects such as buttons, fields, and listboxes for building forms or connecting to databases.

When you're ready to publish your animation, you use a separate program called the Web Installer. The Installer lets you create either a Java applet or an animated

GIF, and you can publish to a local drive or to the Internet using the built-in FTP client. Web Installer creates an HTML page and puts the tag lines and code on the Windows Clipboard so you can paste them into the existing HTML page. Every Web-

Motion applet includes the WebMotion player, which consists of about 20K of additional classes. Aside from this, our test applets were very small.

WebMotion is not as well rounded or as powerful as some of

THE TOOLBOX gives you VCR-like controls to start, stop, rewind, and step through your animation as you're building it.

the tools reviewed here, but its features and effects make it a capable and easy-to-use tool for adding simple animation to Web pages.—Greg Alwang

Astound WebMotion 1.02. Street price: \$50. Requires: 486-based PC or better, 4MB RAM, 5MB disk space, Microsoft Windows 3.x, 95, or NT 4.0. Astound Inc., Sunnyvale, CA; 888-427-8686, 408-720-0337; www.astound.com. Choose 500 at www.pcmag.com/infolink.

NEC Systems Laboratory Inc.

AuraLine Multimedia Creation Kit

AuraLine Multimedia Creation Kit 1.0 (\$20 street) is actually a major upgrade to a product formerly known as NetML. AuraLine is short on some of the features needed to compete in this field. This product

SUITABILITY TO TASK

							
POWER	Astound WebMotion	AuraLine Multimedia Creation Kit	Hyperwire	Jamba	Java Studio	Lotus BeanMachine for Java	PageCharmer
Multimedia	Good	Good	Good	Excellent	Poor	Fair	Fair
Forms/databases	N/A	N/A	Good	Good	Excellent	Good	N/A
Deployment	Fair	Good	Good	Good	Fair	Excellent	Poor
EASE							
Multimedia	Good	Fair	Good	Good	Poor	Excellent	Good
Forms/databases	N/A	N/A	Good	Good	Fair	Excellent	N/A
Deployment	Good	Good	Fair	Excellent	Fair	Excellent	Poor

N/A—Not applicable: This program is designed solely for animation.

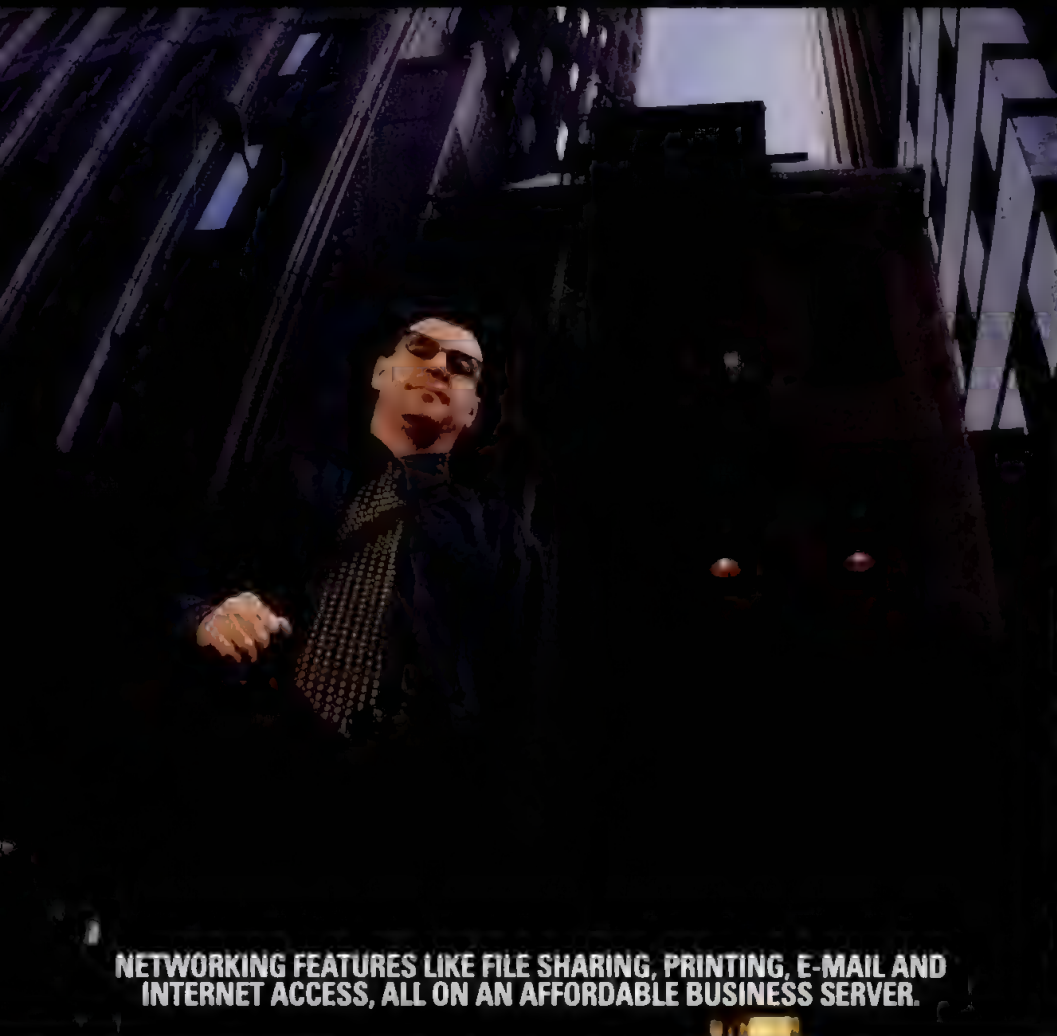
To test Java applet tools, we evaluate each program's ability to create two categories of applets: multimedia applets and applets designed for Web forms and database connectivity. For our final task, deployment, we gauge the program's ability to output and publish applets to a Web page.

For the **multimedia** task, we consider the program's ability to import graphics (especially animated GIFs and imagestrips) and generate sequences of images.

To judge a package's **forms/databases** capabilities, we evaluate the tools ability to create forms and applets that connect to databases.

Once you've finished creating an applet, the options for **deployment** are numerous. Factors we weigh here include publishing wizards, the output formats available (CAB, JAR, ZIP, and standalone Java applications), the size of the accompanying class files, and whether or not the product includes an FTP client.

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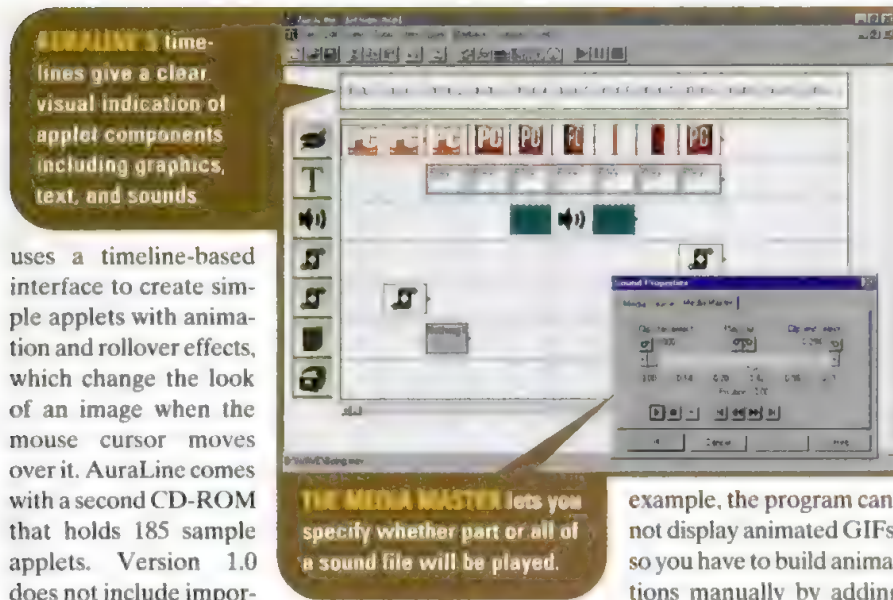
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uses a timeline-based interface to create simple applets with animation and rollover effects, which change the look of an image when the mouse cursor moves over it. AuraLine comes with a second CD-ROM that holds 185 sample applets. Version 1.0 does not include important features such as animation paths, however. And like Astound WebMotion, the tool lacks forms and database connectivity tools. We also found AuraLine to be more difficult to use than other programs in this roundup.

AuraLine's Multiple Document Interface (MDI) allows you to edit two or more applets at the same time and copy and paste objects between them. Unlike Interleaf's Jamba or Lotus BeanMachine for Java, AuraLine does not have wizards to help you get started. Instead, you build applets by inserting images and sounds onto a spreadsheet-style timeline that can be divided into seconds or tenths of seconds. Different rows on the timeline represent graphics, text, and audio. AuraLine supports AVI, JPEG, and GIF files, and you can convert BMP files to GIFs or JPEGs. You can apply several types of effects, and you can create dissolves that fade out one image as another fades in.

The brains of an AuraLine applet are its logic objects, which appear on other timeline rows. A logic object is a control that makes the applet jump to a specified column in the timeline or link to a URL. These events can be triggered at a specific point on the timeline or in response to a mouse click. You can associate a hot spot with a logic object by opening the Page Layout window and dragging a rectangle to any size and position, but you cannot create nonrectangular hot spots.

AuraLine's animation features are less extensive than the competition's. For

example, the program cannot display animated GIFs, so you have to build animations manually by adding

GIF or JPEG files one at a time.

Similarly, AuraLine's publishing options are limited. The program includes a preview window, but you may sometimes find it difficult to tell whether you are in preview or edit mode. When you save an applet, AuraLine generates a small control file in NEC's proprietary MCP format. You must then open the Tools/Package dialog box to send the associated applet, together with its multimedia files—an 88K class file and a 36K CAB file—to your hard disk or to an FTP site. The program generates an HTML file that runs the applet, but it does not warn you that the file includes pathname references to an AuraLine CAB file that is stored locally. Unless you remove the pathname before you publish the page, no visitor using Microsoft Internet Explorer will be able to run the applet. NEC promises a fix in the next version. A useful output option lets you save the MCP file as a PowerPoint presentation.

NEC plans to release a new version this fall that will address many of

WIRE VIEW is Hyperwire's visual programming tool for events and actions.

these weaknesses. In the meantime, you'll be better off with one of the other products reviewed here.—*Edward Mendelson*
AuraLine Multimedia Creation Kit 1.0. Street price: \$20. Requires: Pentium-based PC or better, 16MB RAM, 15MB hard disk space, Microsoft Windows 95 or NT 4.0 or later. NEC Systems Laboratory Inc., San Jose, CA; 888-223-4385, 408-433-1358; www.auraline.com. Choose 501 at www.pcmag.com/infolink.

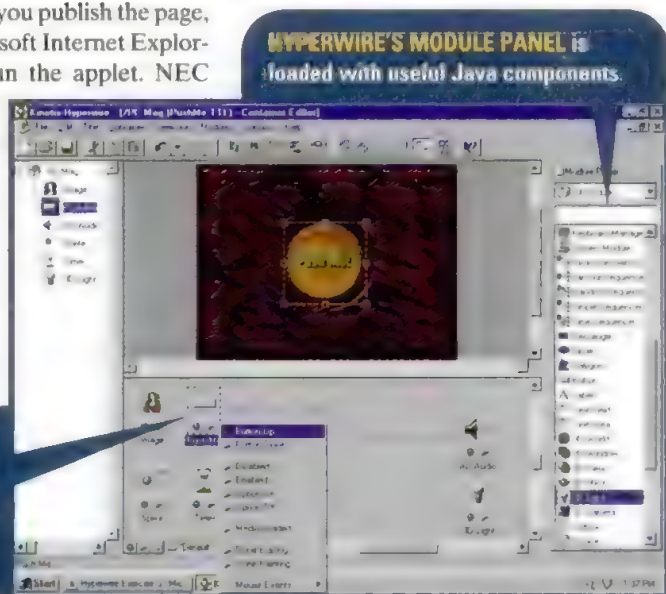
Kinetix, a division of Autodesk Inc.

Hyperwire

With a street price of \$250, Kinetix's Hyperwire 1.0 is one of the highest-priced packages in this roundup, but it is also a powerful and versatile object-oriented authoring environment. Its sophisticated features make it better suited to professional Web designers and programmers than to first-time content creators.

Hyperwire has not been updated since it won our Editors' Choice last June, but it is still the only tool with direct hooks to 3-D modeling packages for incorporating 3-D content, such as views and virtual worlds, into your Java applets. This power comes at a price in terms of bandwidth: Users must download a 180K runtime class in order to run Hyperwire applets.

Hyperwire's visual authoring concept is similar to that of Java Studio. You arrange objects, called *modules*, in a work area and draw connections between them to create a working applet. The Module Panel lists more than 30 standard objects that can be



SUMMARY OF FEATURES

Java Applet Tools



	Astound WebMotion 1.82	AuraLine Multimedia Creation Kit 1.9	Hyperwire 1.0	Jamba 2.1	Java Studio 1.0	Lotus BeanMachine for Java 1.1	PageCharmer 1.5
General Features							
Street price	\$50	\$20	\$250	\$200	\$80	\$160	\$100
Wizards for creating applets	■	■					
Proprietary preview/Browser preview	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
User can edit in preview mode	■	■	■	■	■	■	■
Tutorial/Sample applets	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
JDK 1.1/JavaBeans support	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multimedia							
Timeline-based/path-based animation	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Graphics file formats supported	BMP, DIB, GIF87, GIF89, JPG, PCX, Photo CD, RLE, Targa, TIFF	BMP, GIF, JPG, PCX, Photo CD, PSD, Targa, TIFF	BDS, DWF, DXF, GIF, JPG, 3DS, WHI	BMP, EPS, GIF, JPG, Photo CD, Targa, TIFF, others	GIF, JPEG*	Animated GIF, GIF, JPEG	GIF, JPEG
Supports GIF image arrays (imagestrips)	■	■	■	■	■	■	■
Can control looping/sequencing	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Includes image editor	■	■	■	■	■	■	■
Color reduction/Transparency control	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Hot-spot/imagemap editor	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Forms/Database Connectivity							
Can build forms	■	■	■	■	■	■	■
Drag-and-drop form building	N/A	N/A	■	■	■	■	N/A
Database connectivity	■	■	■	■	■	■	■
Database formats supported	None	None	CSV text	CSV text	JDBC, ODBC	JDBC	None
Window for editing Java code	■	■	■	■	■	■	■
Users can import their own Java extensions	■	■	■	■	■	■	■
Can incorporate external applets/JavaBeans	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Deployment							
Includes FTP client for deploying applets	■	■	■	■	■	■	■
Publishing wizard	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Outputs CAB/JAR/ZIP files	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Supports signed CAB files	■	■	■	■	■	■	■
Can create standalone applications	■	■	■	■	■	■	■

* This feature is supported by an included third-party product. N/A—Not applicable: The product does not have this feature.

used in applets. As you create connections, Hyperwire draws “wires” from one object’s *output port* to another’s *input port*. Output ports specify events such as the press of a button. Input ports give instructions such as start and stop animating. Once you get the hang of this technique, you can create basic applets with ease, though this method is certainly not as easy as using wizards.

Hyperwire supports path-based animations using separate GIF files or image-array files. Setting and editing animation paths is not as intuitive as in Astound WebMotion or Interleaf’s Jamba. Besides creating simple applets, Hyperwire also provides many high-end objects such as variables, math functions, sequencers, and 3-D components, which will appeal to professional designers and developers who want to build sophisticated applets.

All the usual forms components such

as buttons, listboxes, tables, and fields are provided, so you can create robust business applets. Since Hyperwire has not yet been updated to JDK 1.1, its database connectivity is limited to simple text files. For engineering shops, Hyperwire links with AutoCAD’s Internet viewer WHIP, allowing you to view and navigate Drawing Web Format (DWF) files from a Hyperwire applet.

Applets can be published as CAB or ZIP files. The 180K runtime file can be generated as a signed CAB, so Microsoft Internet Explorer users need only to download it once. A log file, called a Publishing Almanac, summarizes projects and even shows approximate download times.

Hyperwire is beginning to show its age. Nevertheless, the tool’s powerful objects will continue to appeal to professional designers and programmers.—GA
Hyperwire 1.0. Street price: \$250. Requires:

Pentium/90-based PC or better, 16MB RAM (32MB for Windows NT), 45MB disk space, Microsoft Windows 95 or NT 3.5.1 or later. Kinetix, a division of Autodesk Inc., San Francisco; 800-879-4233, 415-547-2000; www.ktx.com. Choose 502 at www.pcmag.com/infolink.

Interleaf Inc. Jamba



With a powerful image editor, a superb animation tool, and a wide variety of object types and clip art, Interleaf’s Jamba 2.1 (\$200 street) provides a powerful Java applet authoring environment. Jamba is probably overkill if you want to create only simple applets to liven up your Web pages, but Web site designers will find Jamba to be the tool of choice for designing sophisticated applets.

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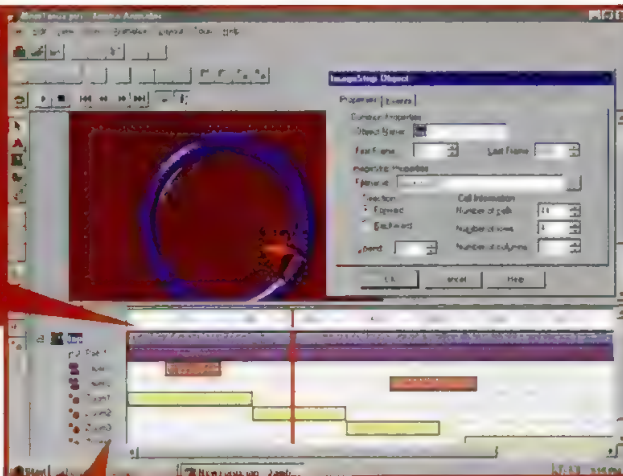
Jamba supports GIF imagestrips, which combine several GIF images into one file and represent them by rows and columns.

This new version of Jamba is significantly easier to use. Wizards make it easier for anyone to create complete Java applets such as guest books, banners, and e-mail forms. Additional wizards are available from Interleaf's site. Other enhancements include Quick Helpers and Quick Selectors, which anticipate your next action when activated. Finally, Jamba now includes more than 78 sample applets.

As in Lotus BeanMachine for Java, in Jamba you drag and drop objects onto a layout area and specify properties, events, and actions. Jamba goes farther by letting you include variables, expressions, and conditions for each object. For instance, you can create an animation object that behaves differently under different circumstances (if the user has pressed a button, for example), or you can create a button that performs a calculation.

Jamba is head and shoulders above the others in this roundup when it comes to visual effects. In addition to basic effects such as dissolves, fades, wipes, and blinds, the bundled Jamba Animator lets you create both timeline- and path-based animations that interact with other applet objects. Animator goes farther yet, allowing you to control layers, zooms, fades, multiple image paths, and loops. And you can insert Jamba events anywhere in the sequence of the animation. Jamba's image-editing utility, ImageLab, is as powerful as some standalone image editors. It supports more than 30 graphics formats and lets you capture screens or import images for cropping, combining, adding effects, or converting between formats.

Jamba supports basic Java objects, such as buttons, text, and animations, but also adds some higher-end objects such as



JAMBA ANIMATOR'S timeline gives you ultimate control over the layers, zooms, image paths, and events within an animation.

a timer, hot spots, e-mail components, and picture push-buttons (buttons with background images that change when pressed).

You'll also find objects for connecting to FTP servers, CGI programs, or external Java and JavaScript routines.

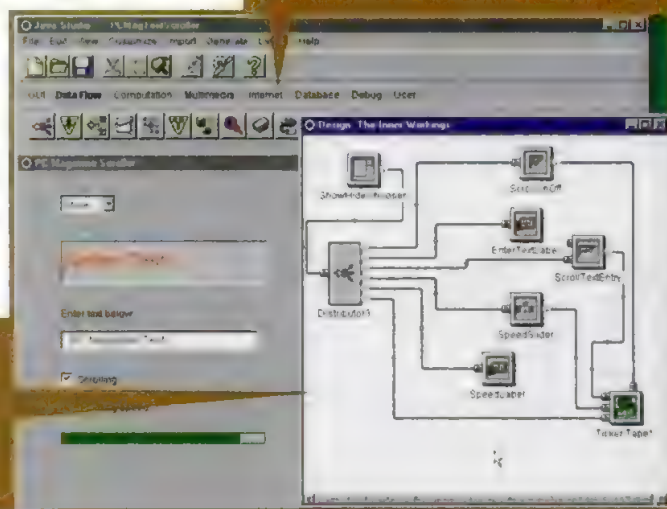
A high-end feature you'll find in Jamba and Java Studio (but no other package in this roundup) is support for interapplet communication, which leads to better interactivity and modularity and results in much smaller applets.

Jamba's Achilles' heel is its database connectivity, which is limited to text files. Interleaf is planning to offer an add-on for connecting to data sources that comply with JDBC (Java Database Connectivity).

Jamba publishes applets as CAB, signed CAB, and ZIP files and includes only those classes used by the applet. Every applet (except for animation-only applets) also requires the 20K Jamba player classes, however. Applets can be published to a local drive, FTP server, or Web server with Microsoft FrontPage extensions.

Although Jamba

THE FLOWCHART design window lets you control the logic of your applet.



JAVA STUDIO'S tabbed toolbar can be customized to include almost any JavaBean or saved Java Studio project.

is now much easier to use, the product is still not for everyone. But Web site designers will find it to be the best animation tool available.—GA

Jamba 2.1. Street price: \$200. Requires: Pentium-based PC or better, 16MB RAM, 15MB disk space, Microsoft Windows 95 or NT 4.0. Interleaf Inc., Waltham, MA; 800-456-5323, 617-290-0710; www.jamba.com. Choose 503 at www.pcmag.com/infolink.

Sun Microsystems Inc.

Java Studio

Written entirely in Java, Sun Microsystems' Java Studio 1.0 (\$80 street) provides an intuitive graphical interface for building complex applets for business and professional use. Although the program is rich in logic, math, and other abstract features, it uses visual tools throughout. Java Studio is a good tool for advanced users who want to develop applets quickly, but most will have more success with a simpler product such as Lotus BeanMachine for Java.

In Java Studio, you construct applets by adding JavaBean components to either a layout window or a flowchart-style "design" window and then drawing the lines that make information flow between components. Dialog boxes make it easy to set the properties of each component and add or remove connectors that send and receive data from other components.

Supplied dataflow components can split and merge data from other components,



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Online Java Resources

Java was the first programming language designed specifically for the Internet, so it is no surprise that the Web offers a rich variety of Java resources. There are dozens of sites with sample applets, utilities, tips, chat rooms, and links to other resources. Many of the sample applets are free for the taking and can be added to your Web pages relatively easily.

The best place to begin is where Java got its start: at Sun Microsystems. Sun's JavaSoft division has its own site (www.javasoft.com) offering extensive Java documentation, a small directory of applets developed by JavaSoft, and links to larger directories elsewhere.

Perhaps the best known Java resource is Gamelan: The Java Directory at java.developer.com. Gamelan's well-organized, up-to-date annotated lists include thousands of applets. You'll find everything from simple banners to real-time weather maps. Gamelan also offers directories for JavaScript, ActiveX controls, and other resources for advanced Web authoring.

Linked closely to Gamelan is JARS.com, a one-stop site for news about Java and independent ratings of applets submitted by developers. You're more likely to find smooth-running applets here than in the vast bazaar of Gamelan, but the selection is more limited.

Unlike Gamelan and JARS, which point you to remote sites to download applets, Java Boutique (javaboutique.internet.com) stores applets on its own server. The applets are mostly simple, but some are highly useful, such as one that displays the contents of a text file in a window.—EM

perform if-then operations, and store multiple data strings for later processing. Data can be passed between Beans, and applets can receive data in the form of command-line parameters. All these components are relatively easy to use and are accompanied with detailed instructions.

The GUI components are also well designed, but don't expect much from the supplied multimedia Beans. The audio player cannot play segments of an audio clip, and Java Studio can't convert WAV files to AU format. The animation control, a reduced version of a third-party applet, supports only the GIF imagestrip format, not animated GIFs, and it does not provide a tool for creating imagestrips.

Java Studio is fully extensible, so if the more than 50 Beans that ship with the program don't match your needs, you can probably find others that do. (More than 20 additional Beans can be downloaded from Sun's site.)

Java Studio's WYSIWYG layout window is always "live," so you don't have to switch between editing and preview modes. When you generate an applet, you can view it in the program's own viewer, the built-in browser, or

any other browser. You can also publish standalone Java applications, JavaBeans, or "packaged Designs." Beans and packaged Designs can be added to the toolbar as a template for other applets. The size of the output files depends on the Beans you include in a project. An applet with nothing but a text label produced 328K of files; of that, 200K was required to run the applet.

A word of warning: Java Studio requires a lot of screen space, and it ran slowly even on our Pentium/200 test-bed. Despite the glitches, Java Studio is a powerful visual tool building sophisticated applets.—EM

Java Studio 1.0. Street price: \$80. Requires: 486-based PC or better, 32MB RAM,

33MB hard disk space, and Microsoft Windows 95 or Windows NT 3.51 or later. Sun Microsystems Inc., Palo Alto, CA; 800-786-7638, 650-960-3200; www.sun.com. Choose 504 at www.pcmag.com/infolink.

Lotus Development Corp.

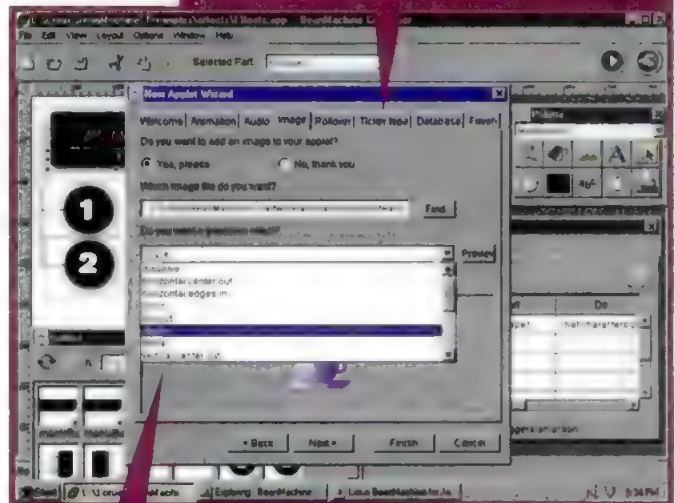
Lotus BeanMachine for Java



Truly designed for nonprogrammers, Lotus BeanMachine for Java 1.1 allows virtually anyone to assemble simple Java applets easily by wiring together existing JavaBeans. BeanMachine (\$160 street) is ideal for Web-team members and content creators who need to add interactivity to existing Web sites but don't want to get caught up in learning a complex interface or Java programming.

In addition to interface and performance improvements, this new version offers full JDK 1.1 and JavaBean support along with the ability to publish Java Archive (JAR) files. You build applets in

YOU CAN CREATE and publish Java applets containing animations, sounds, controls, and database connectivity in minutes.



BEANMACHINE'S NEW Applet Wizard walks you through building applets by asking basic questions in laymen's terms.

the uncluttered Composer. A tool palette lets you choose from *control* parts such as buttons, panels, and text boxes; *multimedia* parts such as images, animations, and sounds; and *network* parts such as e-mail links, URL links, and database connections.

To add parts to an applet, you simply drag them from the palette to the Compos-

er canvas. The Detail window has tabbed pages for *properties*, such as the size or color of text, and *connections*, such as mouse events (mouse-over, single click, double click, and the like), for each part. You can select events, parts, and actions from drop-down lists in the Detail window. The Gallery window is used to preview thumbnail images or sounds.

If you dare, you can write code by hand in the Java window. You can even grab a part from the applet canvas and paste it into the Java window to expose its methods, though only experienced programmers will want to delve into this feature.

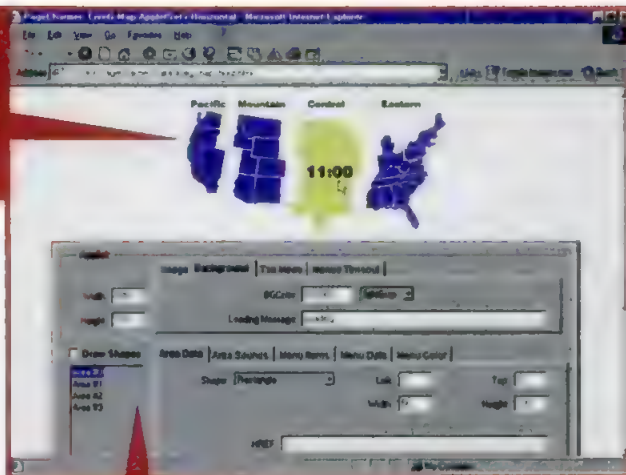
The handy New Applet Wizard walks you through the process of creating basic applets containing animation, sounds, images, special effects, and even database connections to any ODBC-compliant or DB/2 database. It's easy to start with the wizard and then add more functionality through the Composer.

BeanMachine supports various visual effects such as wipes, dissolves, and fades through a transition property. Animation consists of a series of GIF images or an animated GIF file. You won't find high-end timeline- or path-based animation features such as those found in Interleaf's Jamba Animator, but BeanMachine offers enough to create simple animations, and it was the easiest to use of any package we reviewed.

The Bean Wizard shows off BeanMachine's JDK 1.1 support by letting you import existing Beans or Java classes to the palette. Applets can be published as compressed CAB, JAR, or ZIP files to a local drive, a Web server via FTP, or a Marimba Castanet transmitter. BeanMachine also lets you publish an applet as an NFX-compatible component, which can be imported into NetObjects Fusion, a Web site design and HTML authoring tool. Once an applet is published, BeanMachine gives you an estimate of how long it will take to download the applet on a 28.8-Kbps connection. Our test animation was a lean 31K JAR file and did not require a separate player.

Though BeanMachine is limited when compared with the likes of Jamba and Sun Microsystems' Java Studio, it is a simple and reasonably powerful solution for those who want to add sizzle to their sites.—GA

IN PAGE-CHARMER
applets are live and respond during editing



ALL PARAMETERS of the applet are set in the tabbed interface of the customizing applet

Lotus BeanMachine for Java 1.1. Street price: \$160. Requires: Pentium-based PC or better, 24MB RAM, 16MB disk space, and Microsoft Windows 95 or NT 4.0. Lotus Development Corp., Cambridge, MA; 800-343-5414, 617-577-8500; www.lotus.com. Choose 505 at www.pcmag.com/infolink.

Mainstay PageCharmer

With Mainstay's PageCharmer 1.5 (\$100 street), rather than actually building applets, you customize the ones that are supplied with the program. Although this approach makes it quite easy to build common applets, PageCharmer lacks the power to create more sophisticated applets, and its options for deploying applets are weak. Other programs, such as Lotus BeanMachine for Java, offer comparable ease of use and more capabilities.

PageCharmer's authoring environment is entirely browser-based. A tabbed dialog box allows you to customize one of the template applets by changing images, text, colors, backgrounds, fonts, speeds, hyperlinks, rollover effects, and other features. Changes appear in real time, and when you're done, you click a button to generate HTML code.

PageCharmer comes with a dozen template applets such as a ticker. After loading the template version, you can specify the height and width, background image, speed and direction, text size and color, and size and color of a shadow behind the

text. More complex applets manage rollover effects, sounds, and pop-up menus.

The most ambitious applet in the package is an imagemap with a variety of rollover effects, including pop-up menus that appear and disappear at customizable intervals. A set of eight world and continent maps can be used as imagemaps, but you can also use any

other graphic. You can even import existing non-Java imagemaps, and the program automatically converts them into Java applets.

PageCharmer also includes a library of 500 GIF images and 55 AU sound files. Graphics rollover effects require GIF files in imagestrip format. The product doesn't include an imagestrip editor, so if you don't use the supplied examples, you'll have to find a third-party editor.

PageCharmer's weak publishing options are its most serious shortcoming. The online manual describes the directory structure you must create on your site and lists the class files you need to upload manually. But you have to study the HTML code to figure out which image files need to be uploaded for each specific applet, because the program doesn't automatically add them to its "Upload to Your Web Site" folder. And PageCharmer does not include its own FTP client.

PageCharmer class files range from 1K to 19K in size, and the largest CAB file is 10K. The total size of all of the package's class and CAB files is a mere 134K, and expert users can upload only the subset needed by their specific applets.

For those willing to grapple with PageCharmer's deployment hassles, it offers a quick and dirty way to build standard Java applets. But it lacks the power and flexibility of a true authoring tool.—EM

PageCharmer 1.5. Street price: \$100. Requires: 486-based PC or better, 8MB RAM, 3MB hard disk space, Microsoft Windows 95. Mainstay, Camarillo, CA; 800-484-9817; 805-484-9400; www.mstay.com. Choose 506 at www.pcmag.com/infolink. **PG**

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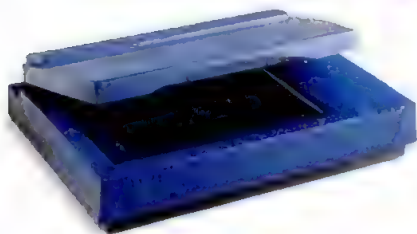
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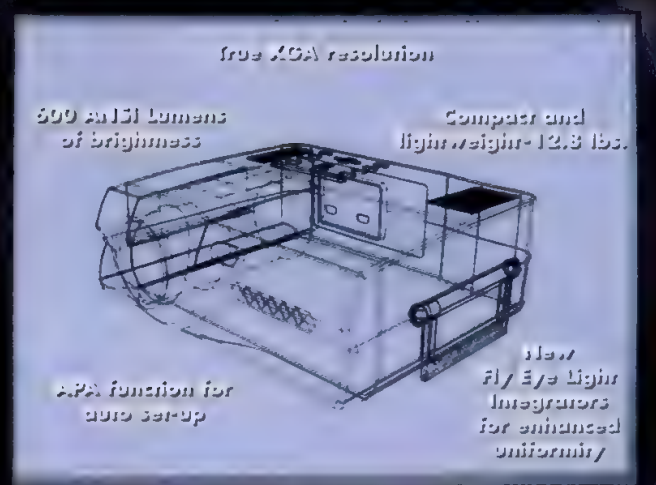
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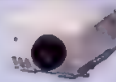


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JAVA

BY RICHARD V. DRAGAN

DEVELOPMENT PACKAGES

The appeal of creating just one application for heterogeneous environments is irresistible to developers.

The best packages we review deliver the latest support for Java language advancements with visual tools and enterprise-level power.

WHAT'S IN THIS REVIEW

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Only two years ago, the Java programming language was really just a modest way to provide animated graphics on Web pages. Today, Java is leading a revolution of sorts for developers with its promise of "write once, run anywhere," and even though the promise is not yet realized, its possibilities have created momentum.

Since our last roundup of Java development tools, a host of new technologies and applications for Java have emerged—from a powerful component model in JavaBeans and database connectivity with Java Database Connectivity (JDBC) to server-side Java with "servlets" and applications running across dis-

tributed systems with Remote Method Invocation (RMI). Our time in the labs with this current crop of Java applications development packages revealed that vendors are working hard and keeping pace with the Java movement.

Java is the preferred method for creating thin-client, database-driven intranet applications and sophisticated distributed systems in which Java helps integrate various hardware platforms across large enterprises. With Java, the very notion of the role of native code is the subject of intense debate and heated lawsuits.

If the Java revolution has changed the rules for developers, it has certainly changed them for tool ven-

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Our interactive version See more demonstrations of Java technology online at PC Magazine's Web site. You'll find narrated walk-throughs of products, interactive features tables, and a place where you can tell us what you think about the reviewed products.

dors. Sun Microsystems' proprietary programming language has given vendors a tough job. Keeping up with emerging Java standards and technologies such as JavaBeans, Java Development Kit (JDK) 1.1 support, JDBC, Remote Method Invoca-

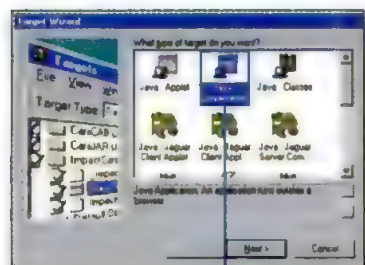
tion for distributed systems, and other new APIs is hard enough. At the same time, ease of use in Java compilers is also necessary because Java brings a new type of developer to the fold: someone more likely to know Visual Basic or another RAD

tool—or none at all. This user wants to be productive on the Internet without having to write a lot of code.

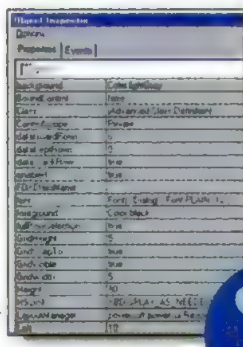
As Java comes to mean more things to more people, tool vendors struggle to target what's really important. Is it the ability to "consume" or reuse JavaBeans efficiently? Is it 100% pure Java compatibility? Is it a migration path for C++ code as it is rewritten or used for the Internet? Is it the high end, where Java is a supplement

Building a Java Application

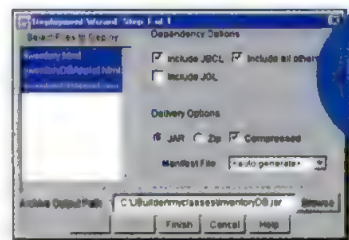
The current crop of development packages offer RAD-tool ease with reusable JavaBean components, along with programming wizards to automate development tasks and access enterprise-level features for designing scalable database apps and distributed systems.



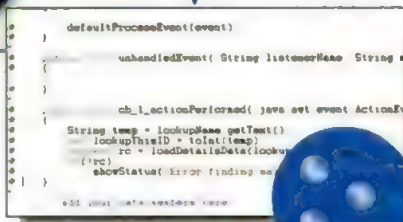
Getting Started Using wizards, developers can create default Java projects such as applets, applications, and even custom JavaBeans with only a few mouse clicks. Wizards write the default code to get you started.



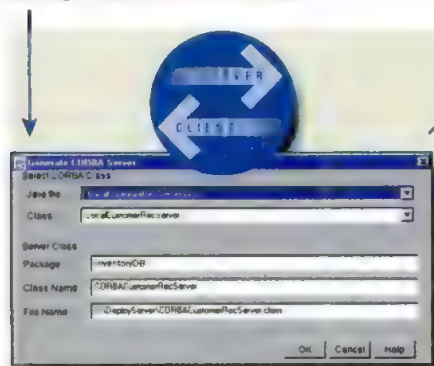
Adding Components Java compilers feature a rich collection of 50 to 100 reusable components called JavaBeans, including advanced objects such as grids, animations, and database components. Designing with Beans means setting properties visually and adding event handlers that contain custom code.



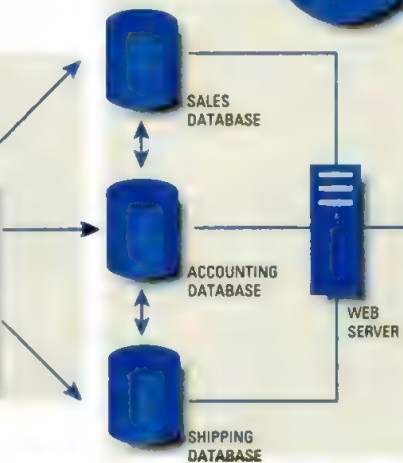
Packaging Easy deployment is one of the standout features of Java database applications. All required files can be bundled in a single JAR file using a deployment wizard. Once it's placed on a production Web server, there's usually nothing to install in the client system.



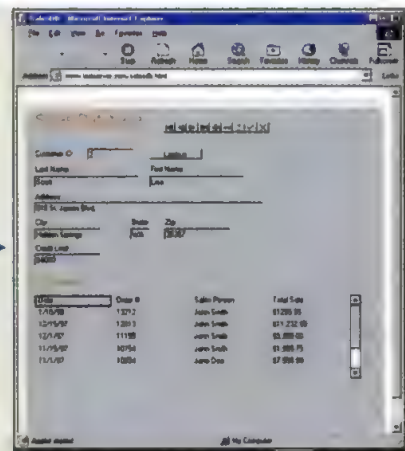
Customizing Code Even with all this wizardry, programmers will need to add custom code to every Java project. Class browsers make the job easier, offering quick access to the properties, events, and methods of each object. "Two-way editing" (featured in JBuilder) means that manual changes to code are propagated back to the visual design.



Adding a Transaction Layer Enterprise-level features, such as transaction management and distributed computing through CORBA, are also supported by most of today's Java tools. This functionality can be easily achieved using built-in tools and wizards.



Database Interaction In distributed computing, the Web server can gather data from multiple database servers across the enterprise.



The Result The finished product runs as a standalone Java application or inside a JDK 1.1 browser such as Microsoft Internet Explorer 4.0. Java applications can run on a variety of platforms.

to CORBA, a way to integrate servers working together in distributed systems?

Compounding the difficulty, no doubt, is the tension between Sun's vision of Java and Microsoft's approach, which allows a role for native code in ActiveX. Vendors have either chosen sides or split the difference, offering applications with the ability to target both Sun and Microsoft Java Virtual Machines (VMs).

For this roundup of Java development environments, vendors have demonstrated their commitment to deliver up-to-the-minute Java capabilities. Nearly all of the six products (with the notable exception of CodeWarrior Professional) stress a RAD component programming style in which components—a combination of standard Abstract Windowing Toolkit (AWT) Java components, JavaBeans, and ActiveX controls—can be assembled together on forms. Regardless of the component type, today's Java developers can design applications visually, setting properties and adding *event handlers*—snippets of code that do the work of a Java applet or application.

We preview the impending releases of Microsoft J++ and SuperCede 2.0 for Java Professional Edition. Those programs were not publicly available during our testing, though we expect both to be at least in public beta by the time you read this.

We reviewed only packages that include their own compilers, but we also look at six of the more impressive Java development products that use the compiler that comes with the JDK 1.1 in the sidebar "More Java Development Options."

The tools we review vary in their support for event handling, which can be particularly tricky in the JDK 1.1 programming model. *Event handling* is the way the program handles user or system events such as clicking a mouse. Basically, programmers need to write *inner classes* in order to attach events to code. In most of the products reviewed here, tools automate that type of overhead.

These Java tools vary as to how much Java a developer needs to know to do this

Editors' Choice

• Sybase PowerJ Enterprise 2.1



All the Java development packages we reviewed deliver the power to develop enterprise-wide applications. Only Sybase PowerJ Enterprise combines

that power with significant ease-of-use features as well as great flexibility and extensibility, and so we recommend it as our Editors' Choice.

PowerJ has excellent drag-and-drop programming capabilities, and its unique Reference Card makes walking through development tasks easy by gathering the methods, properties, and command syntax for any imported or created JavaBean. The Reference Card can help you whether you're new to Java programming or an experienced developer, because it significantly reduces development time.

Developers have many options for how to proceed with PowerJ because of the flexible nature of the environ-

ment. You can simply plug new versions of the JDK into the program, eliminating upgrade worries. PowerJ also shines when creating a distributed application. Its Jaguar CTS transaction server is excellent, but you can also choose COM, CORBA, or RMI to do distributed computing.

JBuilder Client/Server Suite from Borland International merits an honorable mention. Like PowerJ, the program offers a capable development environment and lots of power to create Java applications. But JBuilder falls just short of being the complete package PowerJ is because of its weaker JavaBean creation tools, its lesser extensibility, and its requirement of more Java knowledge on the part of the developer.

component assembly. For those to whom ease of use is important, a tool such as Visual Café for Java 2.1, Database Development Edition, minimizes the need to tweak Java code manually. Several of the tools here, such as Sybase PowerJ Enterprise 2.1 and Visual Café, provide wizards to automate simple interactions between controls, so you don't need to know much Java to use them.

The next important area of functionality to consider is support for database connectivity. Ultimately, this is done through JDBC, but vendors vary in how close they require the developer to be to the nitty-gritty of database programming. The most successful tools, such as JBuilder Client/Server Suite and Visual Café, offer higher-level classes that abstract the

details of JDBC to make programming easier. They also offer data-aware JavaBeans that can be attached to data over the Internet with little or no programming.

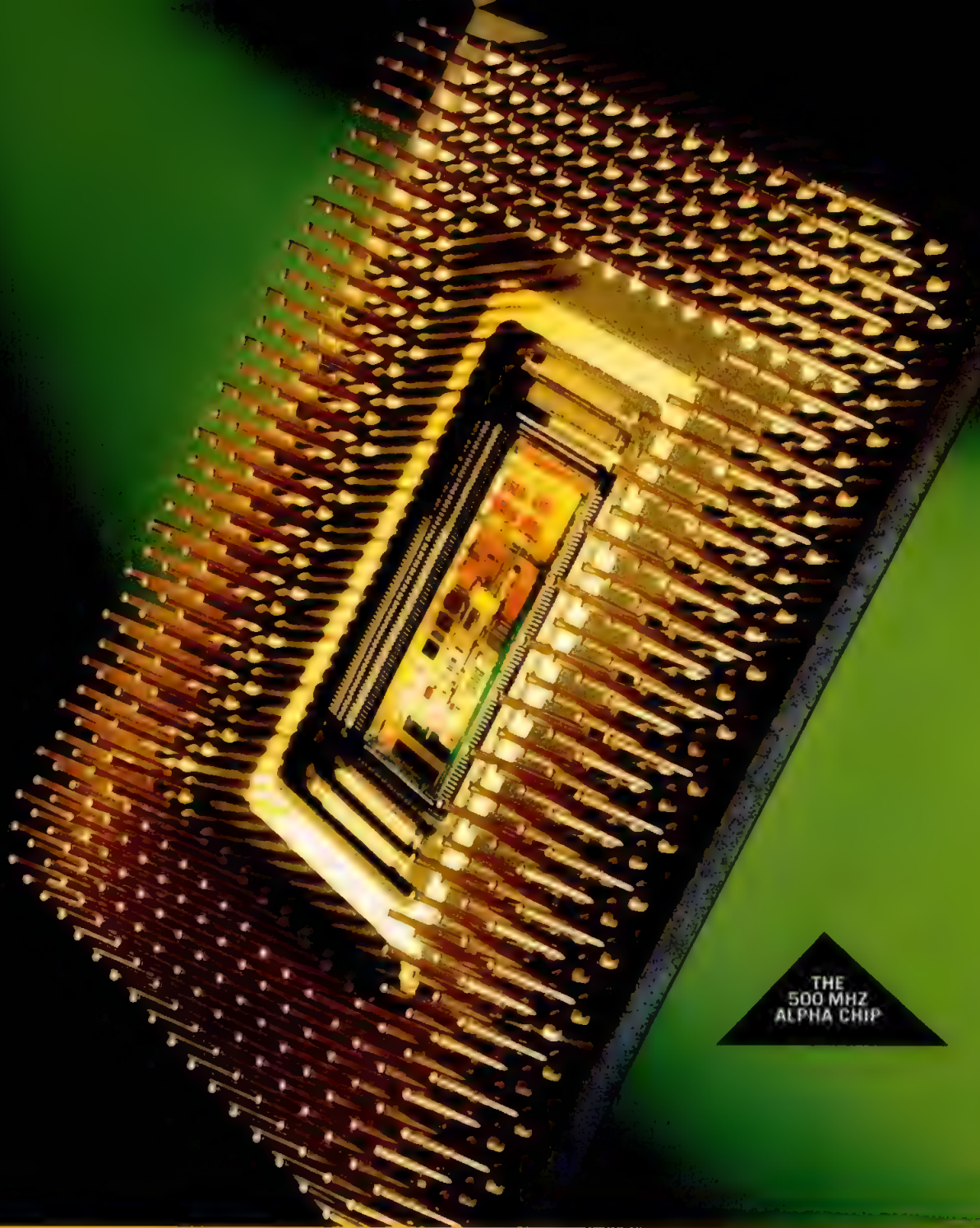
Further, in most of the tools here, you get wizards to automate creating SQL queries for connecting to databases and for creating basic forms from database queries. Using today's Java packages, such as JBuilder and Sybase PowerJ, you can quickly create database applications that rival their native-code equivalents in features (if not performance) and have comparably short development times.

When it comes to deployment, most of the tools here offer automated wizards for the Java Archive (JAR) format used in JDK 1.1 to distribute Java applications. Our testing found few differences among packages for runtime speeds, and compile speeds also varied only slightly. We did find more notable differences in output file sizes, where Sybase PowerJ performed the best.

By and large, this set of packages demonstrates that Java is ready for even

Our Contributors RICHARD V. DRAGAN is a programmer at PC Magazine Labs. GREG ALWANG is a contributing editor of *PC Magazine*. TODD E. COLUMB and HEATH H. HEREL are consultants at Walker Systems Support, a computer management firm. NEIL MARTIN is president of Plum Hall Europe, and RANDY MEYERS is president of Silverhill Systems. JAY MUNRO was the project leader, and DAVID LIDSKY was the associate editor in charge of this story.

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Metrowerks Inc.

CodeWarrior Professional

Even though Metrowerks' CodeWarrior Professional 2.0 (\$599 list) offers excellent cross-platform support and a deft development environment, it lags significantly behind its competitors. CodeWarrior lacks basic RAD tool visual design and the database connectivity wizards that today's programmers have come to rely on to facilitate the repetitive chores of program development—all of which you'll find in JBuilder Client/Server Suite, Sybase PowerJ Enterprise 2.1, and Visual Café for Java 2.1, Database Development Edition. Metrowerks plans to add RAD support in a future release. Until then, CodeWarrior is undoubtedly the most code-centric product in this roundup, and it's definitely only for the expert Java programmer.

In order to use CodeWarrior at all, you must be extremely familiar with the conventions of JDK 1.1 programming. Even though it has a high-end focus, CodeWarrior is actually rich in its help and tutorials, not only for core Java but for the various add-on packages bundled with the product. Voluminous online help and tutorials are shipped on a reference CD-ROM. So are documentation and sample code from third-party vendors.

Despite its complete lack of RAD-style visual component support, we found CodeWarrior's programming environment a pleasure to work with. CodeWarrior's integrated development environment (IDE) is excellent, but it doesn't support macros to ease development tasks. You can, however, customize toolbars and keystrokes for common commands. Syntax highlighting for C/C++, Java, and Pascal comes standard and can be extended by the user. One feature that stood out is the ability to compare source files easily, with differences in two files highlighted.

Without a visual component editor, we had to design forms for our test applica-

How JavaBeans Work

As great as the hype over Java has been in the general computing world, the only thing that can approach that din within the developer community is the excitement over JavaBeans. But what exactly are JavaBeans and why are they so important?

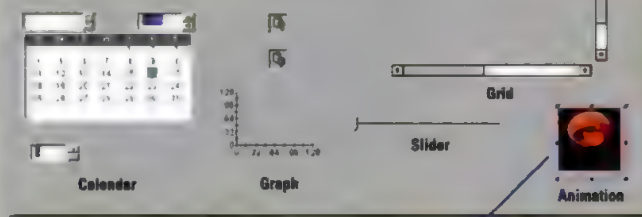
Put simply, JavaBeans are reusable building blocks that make up object-oriented Java programs. Technically, JavaBeans are defined by an application programming interface (API) specification for a visual component architecture based on the Java language. Ideally, any Java components conforming to the JavaBeans component model can be reused in any other JavaBean-compliant application. For instance, if you develop a program object for calculating mortgage interest and you follow the JavaBean component model, then anyone can take that mortgage Bean and plug it into any other Java application that uses the JavaBean specification.

This is significant to applications development because at no other time did we have a truly standard component model that was platform-independent. You can develop components using your own specifications with programs such as C++, but other programmers need to know exactly what specifications you use in order to reuse the components. This issue is resolved with JavaBeans because every Bean not only complies with the JavaBean model, it also carries with it all its properties and methods, which can easily be garnered through introspection—a JavaBean property whereby any visual builder tool can analyze and report on how a Bean operates.

The JavaBean specification, developed by a consortium of companies led by Sun Microsystems, states that any JavaBean can be manipulated visually in a builder tool. It goes on to say that all Beans must support object properties, such as the font style for a text

What's a JavaBean?

The JavaBeans standard allows Java programmers to reuse components, called *Beans*. All of these items are JavaBeans.

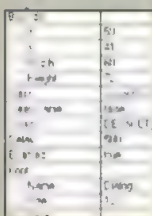


Most of the tools in this roundup come with 50 to 100 prebuilt JavaBeans for a variety of common programming tasks, including such advanced user interface objects as animations. Beans are also used for database connectivity. Common database objects such as connections are represented by invisible beans.

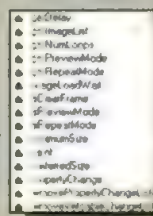
What's Inside a JavaBean?

Because every JavaBean should conform to a standard model (defined in Sun's JDK 1.1), Beans from different vendors are interchangeable.

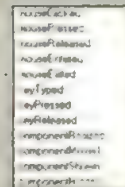
Reflection and introspection allow a Java programming tool to "read" a Bean's contents.



Properties: size, color, and other attributes.



Methods: built-in functions that can be called by programmers.



Events: actions that are "fired" by the Bean, such as mouse clicks.

In reflection, the JavaBean function names conform to the standard. In introspection, capabilities are stored in a BeanInfo structure and can be read explicitly. Either way, the Bean's capabilities can be examined before the Bean is imported into IDE.

object, Java methods or actions that are made available to other components, events representing the interaction between Beans, and object persistence where the customized state of a Bean can be saved and retrieved at a later time. Beans must also support inheritance—the borrowing of properties from other Bean classes.

Until the release of Microsoft Internet Explorer 4.0 and Netscape Navigator 4.03, JavaBeans were more myth than reality. Those browsers support the JDK 1.1 specification, of which JavaBeans are an integral part. You could run Bean-enabled applets in Sun's little-used HotJava browser or by using awkward plug-ins to Microsoft's and Netscape's 3.x browsers that didn't always work. Now that Bean support is more available, JavaBeans have become the component of choice among Web-savvy developers.

This sudden popularity in Beans has

given rise to a host of tools for both developers and Web page designers. Java development tools let programmers write new Beans and *consume* (import) existing Beans to develop large-scale applications. The tools include basic Bean components for adding buttons, text, and fields as well as more advanced Beans for connecting to enterprise databases.

The beauty of the JavaBean specification is that it lets you plug in any Beans to whatever Bean-compliant tool you use. More important, it allows nonprogrammers to write Java applets without coding, simply by assembling Beans using a visual builder.

In addition to Java's cross-platform capabilities, the advantages to using Beans are immense. Businesses can save valuable resources by reusing components and by allowing Web designers, rather than expensive programmers, to develop the applets.—Greg Alwang

Where Do I Find a JavaBean?

By selecting from a component palette, Java programmers can design visually. They get the best of rapid applications development (RAD) by assembling components—even those from different vendors—without having to start from scratch, and this increases productivity.

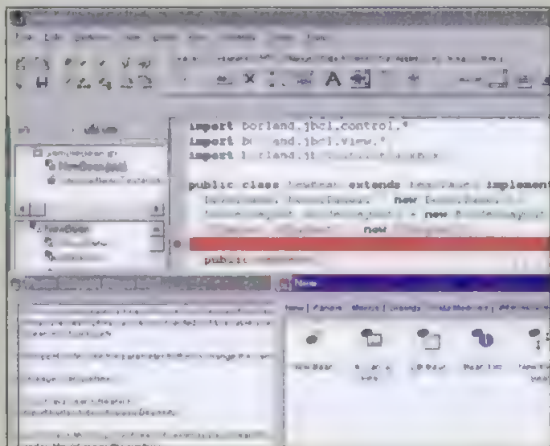


The component palette from Symantec's VisualCafé organizes JavaBeans by category for quicker access to drag-and-drop component programming.

How do I build a JavaBean?

You can code it manually, use a template or wizard, or combine these techniques.

Several of the tools in this roundup have wizards to build basic Beans, but it's up to the programmer to provide the expertise to finish the job, following the rules of the JavaBean component model.



The BeanExpress wizard from Borland's JBuilder creates a default Bean, which then can be customized at the source-code level.

tion by manually writing code for creating, resizing and handling events for individual components. This can be particularly tedious without any support for event-handling for components using the *event handling* model and *inner classes* commonly used in JDK 1.1 programming.

To connect an application to a database, you have to write database code through JDBC manually. Having to manage the details of working with databases yourself is a significant drawback.

You are not entirely on your own when creating applications though, and CodeWarrior includes several tools to assist in writing and maintaining Java (and C++) code. We found the class browser in CodeWarrior to be a deft and capable tool. Using this feature, you can add the required classes and methods for all kinds of Java programming conventions, from designing JavaBeans to programming with databases. You will need to supply much of the expertise yourself, however. For designing groups of classes, the hierarchy window clearly shows the layout of classes with inheritance relationships.

CodeWarrior is notable for facilitating multiple language and cross-platform development and cross-platform deployment. The CodeWarrior Project Manager is the starting point for all projects, and you can mix and match Java and C++ targets, making it a fine choice for those who need to work with native methods in Java.

To allow for team development on various platforms, CodeWarrior runs on Windows 95 and NT 4.0 and the Mac OS right out of the box. Tools for all these environments are included on the same CD-ROM, and Java source and project (.MCP) files can be shared across environments. CodeWarrior also has separate versions for such disparate platforms as BeOS, PalmPilot, and a wide variety of embedded operating systems.

Regarding cross-platform deployment, you can target CodeWarrior applications for two different Java VMs—Microsoft Java VM and Sun Microsystems' JDK 1.1.4. This means you can build applets and applications that use ActiveX (and the Microsoft VM), as well as pure Java solutions with the same toolset.

CodeWarrior also lets you access a wide range of Java technologies using the same tool. The product ships with

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Microsoft's JDK 2.0 and a variety of Sun developer tools including the JDK 1.1.4, the Sun Servlet Developer's Kit for building server-side Java components, and a beta version of Sun's Swing components for advanced interface design.

Once you've chosen your project and written your code, compiling projects from within the CodeWarrior environment is easy. A nice touch is the precompiling step that lets you check syntax on source code first. Within the project window, you can also select which modules to debug and then skip the modules you don't want debugged—an invaluable aid when you're debugging Java code or mixed Java and C/C++ modules.

After you have built a project successfully, you'll find CodeWarrior's debugger is also a strong feature, its only fault being that it isn't yet integrated into the main IDE. In testing, we found debugging applets in a browser works best with Internet Explorer 4.0. We found that breakpoints were ignored when debugging in Navigator 4.0.

The basic debugger feature set is sound. You can set watches, breakpoints, and trace through code, including mixed Java and C/C++ projects, seamlessly. You can also intercept Java exceptions at the point where they occur.

One of the wizards CodeWarrior does have is the capable deployment wizard, which generates JAR files in both compressed or uncompressed formats. The program provides good granularity to assist you in finding which modules are included in a given Java component.

The lack of a visual designer and database wizards will send mainstream programmers looking elsewhere for their Java needs. But for the high-end programmer who wants low-level access to a wide range of Java technologies or requires its cross-language or cross-plat-

form abilities, CodeWarrior is certainly a product to consider.—*Richard V. Dragan*
CodeWarrior Professional 2.0. List price: \$449. Metrowerks Inc., Austin, TX; 800-377-5416, 512-873-4700; www.metrowerks.com. Choose 511 at www.pcmag.com/infolink.

Borland International **JBuilder Client/Server Suite**

Just as Sybase has built upon its client/server development tools to create a top-notch Java product, Borland expertly brings its application expertise to the

switch you between a code window and a visual design environment.

Borland extends this power through Two-Way-Tools. You can make a change in either the code window or the visual environment, and the change is immediately rendered in the other environment. This holds true whether you are adding a component to your project or simply changing an existing component's properties. Although Visual Café offers two-way programming, it cannot perform as many two-way tasks as JBuilder, especially when you're writing code by hand and want to see it rendered in the visual environment.

The property Inspector in the visual

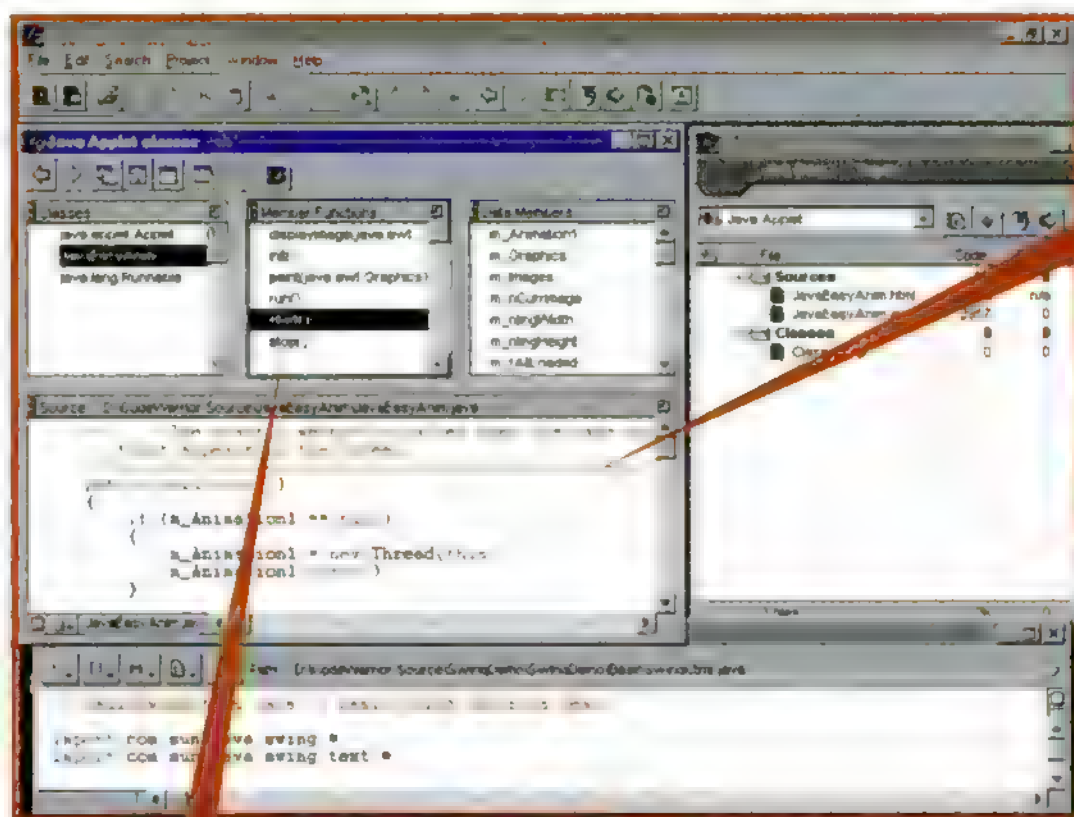
environment gives you at-a-glance insight into the nature of each component. The Inspector also provides a means of accessing all the events associated with a component. Double-clicking on an event in the Inspector

creates that event in the code window. JBuilder handles the insertion of the basic code necessary to handle the event, leaving you to fill in the missing pieces. This is more than mere stub code, but some hand-coding is still required.

Another excellent JBuilder feature is the AppBrowser. Most products include a class browser, and JBuilder's AppBrowser certainly provides the raw power that you would expect from one. But JBuilder sets itself apart by giving you the ability to view only the pieces of a project you are interested in, without requiring you to sift through all of the inheritance. This means you don't have to view all the properties, events, and methods of an object's parent.

In case you want to see the inheritance, that information is all available by simply drilling into an object and back into its parent classes. When you work back up to project level, the information gets pushed into the background, keeping your view of the project as clean as possible.

You can also drop components out of the AppBrowser while keeping them in your project, so you only have to worry about the piece you're working on. When you compile, JBuilder handles dependencies for you at the same time, pulling all the required components back in. JBuilder also lets you open a



CODEWARRIOR stresses writing code manually, but the class browser lets you manage Java classes easily.

CODEWARRIOR, the most code-centric product reviewed, is for Java experts only.

Java world, endowing JBuilder Client/Server Suite (\$2,499 list) with some of the features that have made Delphi and

IntraBuilder such strong players in their respective markets. The similarities don't end there, as JBuilder delivers an excellent interface, strong distributed computing options, and powerful two-way programming tools. Ultimately, though, JBuilder's weak JavaBean creation tools and its barrier to entry for inexperienced Java programmers leave it just short of Sybase PowerJ Enterprise 2.1's total package.

Experienced developers will have no difficulty digging into JBuilder and gaining maximum productivity. The IDE is well designed, presenting all pertinent information through a series of clean tabbed pages, rather than the jumble of windows used by VisualAge for Java 1.0 and Visual Café for Java 2.1, Database Development Edition. Simply changing the page you are viewing will seamlessly

class or component and work with it in the AppBrowser

JBUILDER'S tabs give you instant access to properties, events, source code, and more. You can switch back and forth from a code window to a visual environment

without adding it to your project.

Not all aspects of JBuilder are as mature as the development environment, though. Its support for JavaBeans cannot compare with PowerJ's, particularly in its lack of support for Bean Customizers. Its tools for assisting in JavaBean creation, the BeanExpress wizards, are still rudimentary.

JBuilder is also clearly not designed for the newcomer to Java. Whereas with Visual Café we could wire together an entire application without ever needing to access the code window, the same does not hold true with JBuilder. A working knowledge of the Java language is essential before you can make the best use of JBuilder.

One of the better tools JBuilder offers is the Resource String Wizard. Using this wizard, we were able to take a component we had written and internationalize it in seconds.

The wizard reads the code in your component, removes all strings that you designate to a resource file, and alters the code to read from the file it created. Changing the language used in the resource file changes the language in your Java component, making for instant internationalization of your application and your code.

As for debugging, JBuilder includes an integrated set of tools for all the tasks you need. The IDE gives you easy access to panes of information on Threads, the Stack, Data, an Inspector, and an expression evaluation dialog. Although this isn't the powerful Scrapbook feature of VisualAge for Java, it is an excellent set of tools for locating problems within

your application. One notable weakness is that you can't debug applications directly in a browser.

JBuilder's support for distributed components is strong. Whether you want to use CORBA or RMI to distribute your component, JBuilder has a very powerful wizard to aid in the process. The CORBA wizard works with some input from you to create an Interface Definition Language (IDL) file from your Java class, and you can quickly compile the IDL file to complete the process. This powerful CORBA ability comes from JBuilder's strong link with the Visigenics' ORB (also available with Pow-

erJ) and will likely improve with Borland's acquisition of Visigenics. You deploy RMI through a similar wizard: They are almost identical, except for the generated output.

You also get the InterBase database server and DataGateway middleware.

This gives you a complete set of tools to build a sophisticated Java solution.

THE INSPECTOR gives you at-a-glance insight into the nature of each component and access to all components.

A strong tool for development without an excessive amount of GUI to wade through before getting down to the code, JBuilder delivers a powerful visual environment for developing Java applications. Still, a willingness to

roll up your sleeves and dig into the code is essential.—Heath H. Herel

JBuilder Client/Server Suite. List price: \$2,499. Borland International, Scotts Valley, CA; 800-233-2444, 408-431-1000; www.borland.com. Choose 512 at www.pcmag.com/infolink.

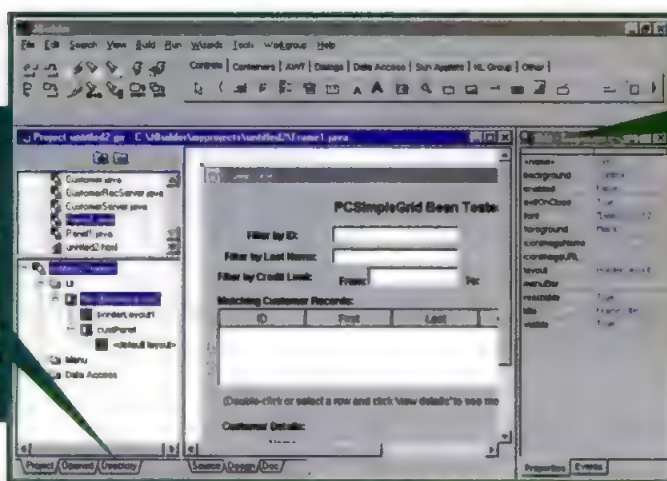
Sun Microsystems Inc. **Sun Java WorkShop**

Best suited for those who have an extensive understanding of the JDK event model and JDBC, Sun Microsystems' Sun Java WorkShop 2.0 (\$189 list, bundled with Sun Java Studio 1.0; \$125, standalone) does alleviate some tedious coding tasks but is designed for the heavy code writer. You have the power needed to create enterprise-level Internet appli-

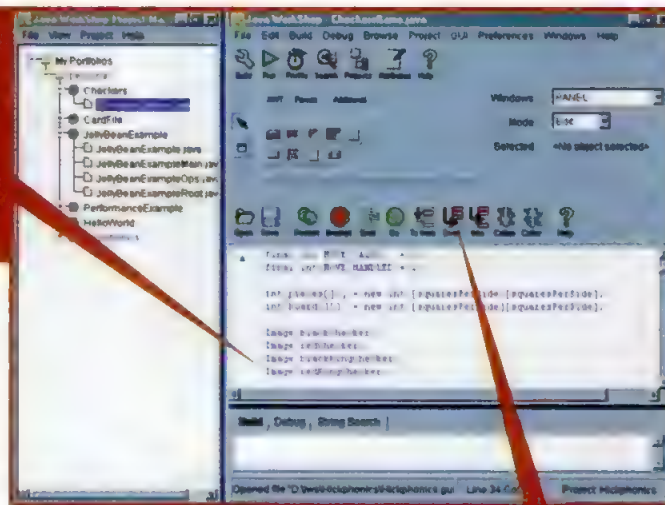
cations with support for multiple native platforms and remote debugging, but you can get that elsewhere, with products such as JBuilder and PowerJ that have more RAD tools. You get some visual aids, such as the GUI Builder for forms, but most visual programming comes from Studio. (For a full

review of Java Studio, see "Java Applet Tools" in this issue.)

Java Studio and WorkShop make a good combination for creating and deploying Java-based applications, but they do not make a great one. A more integrated solution would be a better choice for most developers.



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JAVA WORKSHOP'S debugging icons increase the control you have when debugging your project

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The development environment in WorkShop is actually the HotJava browser, meaning your workspace is not as polished as, for example, PowerJ's user-friendly interface is. Sun wanted the entire process from development to deployment to have a browser-interface feel, and the IDE definitely gives you the feel of working on the Web. But unfortunately, that also extends to the lackluster responsiveness that hinders many browser-based applications. On our test machine (with a Pentium/166 processor, 64MB of RAM, and Windows NT 4.0), changing projects, opening the GUI layout editor, and other basic functions left us waiting as if we were

on the Web. The IDE did hang a couple of times during testing, but we were able to recover without rebooting.

The Visual Java GUI Builder uses a grid-bag layout manager to support RAD. This consistent screen format was helpful for creating windows, buttons, and text fields, but database connections, for example, cannot be built graphically with WorkShop.

WorkShop consumes and creates JavaBeans and handles all aspects of Beans, including BeanInfo files, customizers (variables such as color and font that the developer leaves for the end user to modify), and creating JAR files. You

have to use Java Studio to create a component, such as a data-aware text box Bean, visually. If you want to modify the code generated by Java Studio, you have to save the code Java Studio creates (which you can't edit in that environment) and then import it into WorkShop.

You have another option when creating database connectivity. A bundled third-party product, Object Design's PSE for Java, provides database support for Java that can be installed and used with WorkShop. Java Studio provides flat-file and relational database access using JDBC calls.

Creating our test database application was partly a visual process but mostly consisted of writing code. We created the labels, fields, and buttons using the GUI Builder. For the core logic of the application, however, we had to hand-write the majority of the code.

The target of your development can be an applet, a Bean, a Java application, or a standalone application. Being pure Java, the applet, Bean, or application will run in any JDK 1.1-compliant browser, meaning HotJava, Internet Explorer 4.0, and Navigator 4.03 or later. WorkShop is JDK 1.1.3-compliant and is itself written in Java. But this also means that you can neither use nor create ActiveX components, which of course is a drawback only if you're developing specifically for Windows. You can write for HP UX, SCO Unixware, Solaris Intel, Solaris SPARC, and Win32 in Java. You can also find plenty of third-party components and JavaBeans already available for Java WorkShop.

For compiling your application, you get two separate command line compilers in addition to the JIT compiler built into the Java VM. Along with the standard javac compiler, the other, highly optimized compiler produced faster executable speeds, but with significantly larger code.

We found WorkShop's debugging capabilities generally standard, but you do get some advanced features. In addition to giving you the ability to step into, over, and out of code, as well as conditional and counted breakpoints with data evaluation, WorkShop includes multithreading and remote debugging across a network. Compiler errors are also displayed in a separate window, with hyper-

More Java Development Options

You have additional choices in Java development packages if you choose to use the Sun compiler. Here are six of the best we've seen.—By Richard V. Dragan

Apptivity 2.0 (Apptivity Developer & Server 2.0)

List price: \$1,995 per machine; Apptivity Server 2.0 user license \$5,000. Progress Software Corp., Bedford, MA, 800-477-6473. www.apptivity.com. Choose 518 at www.pcmag.com/infolink.

Server-side Java. Apptivity Developer is a RAD tool that lets developers build both client-side and server-side Java for true multitiered systems and partitioning of work among servers, producing especially thin clients. Its component programming uses custom JavaBeans many of which are data-aware. The environment's particularly strong in its control of databases, with wizards to automate common database programming tasks. Apptivity's strength is its integration of server-side support where server-side events, such as database events, can be programmed using the same IDE. Both client- and server-side components have full JDK 1.1 support.

JDesignerPro 2.3

List price: \$695. Bulletproof Corp., Los Gatos, CA, 800-505-0105; www.bulletproof.com. Choose 519 at www.pcmag.com/infolink.

Team development. RAD tools and easy deployment are the strengths of JDesignerPro, a 100% Pure Java development tool. The design environment itself can be networked to facilitate team programming. Its IDE includes JavaBeans for database access and query wizards that connect to corporate data through JDBC or the included proprietary middleware database server. Highlights include advanced charting capabilities, a built-in HTML browser component, and e-mail support for Java clients.

Parts for Java 2.0

List price: \$149. ObjectShare Inc., Irvine, CA, 714-513-3000; www.objectshare.com. Choose 520 at www.pcmag.com/infolink.

Distributed computing. Parts for Java 2.0 is a RAD-tool programming environment. You assemble components or parts, which are JavaBeans (including third-party components). While some Parts products of the past have adopted a new programming model, this tool will be familiar to any RAD-tool developer. It offers access to events for each control and good database and distributed capabilities, including an Object Request Broker. A future version will have even more extensive distributed capabilities.

Sapphire/Web 4.0

List price: \$4,995 per developer. Bluestone Software Inc., Mt. Laurel, NJ; 609-727-4600, www.bluestone.com. Choose 521 at www.pcmag.com/infolink.

Open architecture. Sapphire/Web 4.0 stresses an open architecture for getting the most out of Java on the enterprise and integrating it with existing technology. The product affords a wide variety of deployment options and industrial-strength support for transaction processing and middleware. For designing applications, the Sapphire/Web IDE is comparable to others here, with a JavaBeans-based RAD-tool approach. The real appeal of Sapphire/Web is that the same server-side components can be deployed differently for all common Web servers, CGI, or Java without changing any code. For the client, you can deploy for Java (JDK 1.1) or HTML.

SilverStream 1.0

List price: Group Starter Pack (with Server and Designer) \$5,995. SilverStream Software Inc., Burlington, MA, 888-823-9700. www.silverstream.com. Choose 522 at www.pcmag.com/infolink.

Creation wizards. The SilverStream package relies on its Designer utility, a capable IDE that supports JavaBeans and wizard-assisted database development for writing Web applications quickly, which can be deployed in both HTML and Java (JDK 1.1) on the client. Features like the Simple Actions wizard hide the details of coding in Java. You also get excellent database wizardry for creating database queries and forms that display data. Highlights of the server-side modules include flexible database connectivity, the ability to deliver push content, and a robust Web application server that manages transactions while building dynamic content on the server.

Super Mojo

List price: \$195. Penumbra Software Inc., Atlanta, GA, 770-352-0100, www.penumbraoftware.com. Choose 523 at www.pcmag.com/infolink.

Cross-platform coding. Similar in spirit to Sun's Java WorkShop, this 100% Pure Java tool offers excellent cross-platform capabilities for writing Java code. Super Mojo supports JavaBeans in an interface that includes an editor, visual designer, and debugger, all written in Java. Unfortunately, this version lacks database wizards (though you can use JDBC manually). Instead, it provides excellent deployment wizards as well as an extensible scripting language that makes it easy to automate coding with components. You can actually develop your own commands for new components, and Super Mojo will write the code. It's also well suited for team development: It bundles the version-control package StarBase.

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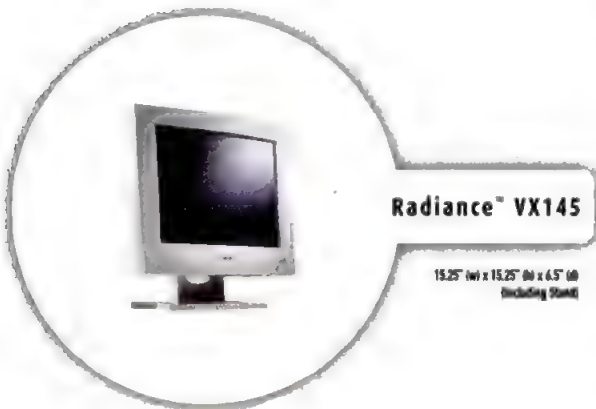
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PERFORMANCE TESTS

Java Development Packages



On our tests, sample applications' file sizes varied only slightly, with the most notable anomalies stemming from compile-time

enhancements. All the Java compilers exhibited marked improvement in compile speed over their C/C++ counterparts, with little difference among them. On our sample test, we found that Java runtime speed doesn't stem from the development package that produced it.

What the Numbers Mean

When testing Java development packages, we viewed them through the prism of testing C/C++ applications development tools. For measuring performance differences among the products, we focused on the compilers, the file size output of each package, and the runtime speed of resulting applications. Here is our examination of the six development packages we reviewed and any additional compiler and optimized settings that any of them possess.

File Size When you're creating applications to be distributed over a network, whether internally or over the Web, file size is an important consideration. We looked at the final file size of our JMark class files. The sizes of the 19 files varied from 34,140 to 50,145 bytes, with Sybase PowerJ Enterprise 2.0 producing the smallest bytecode and Sun Java WorkShop 2.0's new fast compiler creating the largest. Because Sybase released Version 2.1 of PowerJ during our testing period, we looked at both Version 2.0 and 2.1 file sizes, and we found that Version 2.1 crept up slightly in size on some class files.

Sun's new fast compiler creates code faster than the standard JDK version, but the price you pay is in a 10 to 50 percent in-

crease in file size, based on our sample. Symantec's Visual Café for Java 2.1, Database Development Edition, offered a code optimization switch, which we tried during one round of testing. We saw no notable difference in performance, though we did observe an approximately 15 percent decrease in size for the optimized files.

Compile Times For the working developer, the time it takes to build a program or recompile after a modification can be important. With C/C++ compilers, the process consists of multiple steps for Windows applications: compile, link, and resource compile. Under Java, you only have the compile step, as the link and resource compile steps occur at runtime.

With two steps removed from the process when working with Java, the resulting compile times we observed in the environments were not so significant as to be a concern for developers. The full-debug timings varied on our JMark sample from the 1.3 seconds that Visual Café achieved (followed closely by Borland's JBuilder Client/Server Suite) to a little over 10 seconds with the Sun JDK compiler. Between those extremes, CodeWarrior Professional and PowerJ 2.1 both took almost as long as Sun's JDK compiler, with 9.4- and 8.6-second compile times, respectively, while JBuilder and Sun's fast compiler were in the 1- to 3-second range.

We do not report compile times for IBM's VisualAge for Java, because it does not have a discrete compile step. The program precompiles as code is loaded into its Repository, so we were unable to time it.

Compared with the typical C/C++ compile experience, all the packages impressed us. When the slowest compiler of 19 .java files takes 10 seconds to complete a full debug, we can report that Java has made significant strides for developers in this aspect of development. Besides quick compilation, several products (such as Visual Café) offered interactive debugging, with which changes to source code are incrementally rebuilt while you debug, further reducing the need for the often time-consuming edit/compile/link cycle of traditional languages like C/C++. We suspect Java's speedier build times will be an influential factor as developers choose between C/C++ and Java in the future.

Runtime Speed Under C/C++, developers' efforts to have the fastest-executing code took precedence, sometimes over all other aspects of applications development. In the world of Java programming, we discovered that the virtual machine (VM) and the just-in-time (JIT) compiler have the ultimate effect on which application executes the fastest, rather than which product built the code.

To measure speed of execution, we compiled JMark 1.02 and ran it to obtain results. JMark 1.02 contains 11 subtests that measure various aspects of the Java VM such as graphics throughput for basic AWT graphics operations, including displaying graphics images. Other specific JMark tests work with Java container classes (Stack, Vector, and Hashtable tests),

OUTPUT FILE SIZES OF A SAMPLE JAVA APPLICATION

Bytes	
CodeWarrior Professional 2.0	35,152
JBuilder Client/Server Suite	41,689
Sun Java WorkShop 2.0, native	40,403
Sun Java WorkShop 2.0, fast compiler	50,145
Sybase PowerJ Enterprise 2.0	34,140
Sybase PowerJ Enterprise 2.1	34,477
VisualAge for Java 1.0	34,501
Visual Café for Java 2.1, optimized	35,476
Visual Café for Java 2.1, unoptimized	41,689

◀ BETTER

integer-intensive calculations (Quick Sort and Bubble Sort tests), and floating-point computation (Complex Arithmetic and Fast Fourier tests). Other subscores measure two important aspects of Java: garbage collection and using multiple threads with graphics.

In this context, we sought to measure differences between compilers by running them on the Java VMs in Microsoft Internet Explorer 4.01 and Netscape Navigator 4.04.

The timings among compilers on a single VM deviated less than 3 percent almost across the board (these scores are not charted). The only major differences on the same VM among compilers stemmed from random garbage collection done by Java. In four runs, we found that one run would take approximately 20 percent longer than the other three, and all of the packages in this roundup displayed the same behavior.

On one test, AWT Blts and Images, which retrieves and displays GIF files, we saw a problem in which the test froze with the Sun Fast compiler and the VisualAge for Java viewer in the IDE. Although we were unable to confirm the problem, it appeared to be a *race condition*, in which threads get out of sync.

How We Tested

In setting the filter for our roundup of Java development packages, we limited inclusion in our main roundup to applications development tools that fully supported JDK 1.1 and that shipped with their own compiler and not the compiler that comes with the JDK (with the obvious exception of Sun Java WorkShop).

In our lab testing, we evaluated both the performance and the functionality of the Java compilers. We based our testing methodology on prior testing used for C/C++ development tools.

Testing focused on compiler performance and the size of the resulting code. We measured three distinct aspects of compiler performance: the speed of a full debug compile, the speed of a partial debug compile, and the speed of execution. Additionally, we measured the size of the resulting classes.

Two code bases served as grist for the compile time testing: our JMark 1.02 source code and a Java Chess application source. To test performance of the Java compilers in our reviews, we used our decommissioned Java benchmark program, JMark 1.02. We previously used JMark 1.02, based on several standard performance algorithms, to evaluate Java virtual machines. Because JMark 1.02 has been superseded by the JMark 2.0 benchmark program with a new code base (see "Java Environments" earlier in this issue for Java VM testing using JMark 2.0), we decided it was safe to let vendors have access to the source code required to recompile. We could not use the JMark 2.0 benchmark test code, because the source code is proprietary to ZDBoP and not available to vendors.

To test the functionality and ease of each Java development package, we invited each vendor and reviewer to work through a script of tasks at PC Magazine Labs in New York City. The purpose was to evaluate the extensibility, power, flexibility, features, and ease of use that each product brings to developing Java

applets and applications. We considered the rapid applications development (RAD) tools, the integrated development environment (IDE), and the wizards that facilitate applications development without making the developer write code by hand. Our in-house testing script looked at a range of developer tasks, from creating simple animations to working with JavaBean components, database programming, and even enterprise-level capabilities for building distributed applications in Java.

Each vendor and author created a simple animation; created, deployed, and consumed a JavaBean; and connected a Java application to a database. The simple animation task used a series of bitmaps to execute a common Web page enhancement applet. If the product had an application wizard or an existing component, we used it.

We explored JavaBean creation in depth. Using each product, we created a basic grid Bean with several properties. We particularly looked for wizards to ameliorate this process as well as those packages that provided BeanInfo support.

COMPILE TIMES FOR NATIVE COMPILER

■ Full debug build
■ Partial debug build

CodeWarrior Professional 2.0

JBuilder Client/Server Suite

Sun Java WorkShop 2.0, native

Sun Java WorkShop 2.0, optimized

Sybase PowerJ Enterprise 2.0

Sybase PowerJ Enterprise 2.1

VisualAge for Java 1.0

Visual Café for Java 2.1,
Database Development Edition

N/A—Not applicable: The product does not have a discrete compile step

Chess Application
Seconds

8.5
4.4

1.9
0.8

8.7
6.1

2.2
1.7

6.2
6.4

8.6
2.7

N/A

1.0
1.0

◀ BETTER

JMark 1.02
Seconds

9.4
5.2

1.8
0.8

10.1
6.4

2.8
2.2

8.2
8.4

8.6
3.8

N/A

1.3
1.2

◀ BETTER

We then deployed the Bean in a JAR file to evaluate each product's capabilities in that regard. Finally, using each product's screen designer, we used the Bean we had created in an application and tested each product's ability to consume JavaBeans and build new ones.

For the database connectivity portion of our testing, we created a customer-order application. Using a local database, the application provides an interface to enter, edit, and browse orders and customers. This aspect of the script represented the opportunity for each product to show the full extent of its capabilities using wizards, rich components, Beans, Swing/AFC, or even ActiveX components to complete the task.

We wanted to see how automated the database programming was in each vendor's product and how much manual coding was required to create a basic database application. After the application was finished, we asked vendors to show off their products' high-end distributed capabilities. Several products came with built-in tools that can move traditional client/server applications into distributed environments using such features as CORBA and RMI, suggesting that today's Java is indeed ready for enterprise-level computing.—*Analysis written by Jay Munro and Richard V. Dragan*

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Adherence to the Java Specification

Plum Hall (808-882-1255, www.plumhall.com) set the standard for testing C++ development tools and their compliance to the C++ specification. Building upon that expertise, Plum Hall has created a set of more than 3,400 Java programs containing over 745,000 test cases for evaluating both Java compilers and Java virtual machines, known as the JVS validation suite. Using this suite of tests, we found that Borland's JBuilder Client/Server Suite and Sybase PowerJ Enterprise 2.1 best conformed to what is considered to be the Java specification, while IBM's VisualAge for Java encountered some problems.

The Java Language Specification (by Gosling, Joy, and Steele; Addison-Wesley, August 1996) and Appendix D of the *Java Programming Language* (www.javasoft.com/docs/books/javaprogram/1.1Update.html) form the majority of the specification of the Java 1.1 Platform. Some HTML documentation at the JavaSoft site (www.javasoft.com) plus a number of other smaller specifications for particular features (such as serialization)

make up the remainder.

The tests in JVS are divided into four categories. Chapter tests are keyed to the chapters in *The Java Language Specification* and *Java Programming Language*, Appendix D, and the tests verify that an implementation supports the features described in those chapters. Negative Chapter tests are intentional violations of the rules to check a compiler's ability to diagnose syntactic and semantic errors. JVS Grinder tests stress operators and primitive and reference data types, and JVS Espresso tests stress the ability of implementations to evaluate complex expressions correctly.

Table 1 summarizes the results of running the Chapter and JVS Grinder tests on the various packages. The number of test programs that an implementation failed to run is broken down into the number of test failures unique to that implementation, as well as where another compiler failed the same test. Test failures unique to an implementation show idiosyncratic behavior and are less desirable than test failures common to several com-

pilars. Common failures may be a sign that the language is still evolving and that actual practice or a common extension is not reflected in the specification documents.

Our testing revealed that IBM's VisualAge for Java does not support *inner classes*, a new Java 1.1 language feature that allows classes and interfaces to be nested within other classes. We also discovered a scalability problem with VisualAge's development environment that caused compile time to increase dramatically when we saved around 3,000 classes in its Repository.

Table 2 shows the results of the JVS Espresso test. JBuilder's and PowerJ's JVS Espresso results deserve special mention. When a program gets such stellar results when tested, it usually means that the program has previously been run against the test suite and that all of the problems that were found were fixed. But the releases of JBuilder and PowerJ in this review were constructed without reference to the JVS tests.

Two effects account for most of the failures in this table. First, CodeWarrior Professional, Sun Java WorkShop 2.0, and Visual Café for Java 2.1, Database Development Edition place invalid requirements on the type of the right operand of a shift-and-assign operator. The fact that so many compilers have the same behavior seems to indicate that many have been derived from the same source code. Second, a few of our test programs caused the VisualAge compiler (and all of the development environment) to hang, and required that the VisualAge task be shut down using Ctrl-Alt-Del.

The final section of the JVS is the Negative Chapter tests. We were not able to determine any significant differences in the ability of the compilers to diagnose violations of the syntactic or semantic rules of Java.—Neil Martin and Randy Meyers

TABLE 1: CHAPTER AND JVS GRINDER TESTS

Compiler	Tests passed	Failures in common with:				
		No other compilers	1 other	2 others	3 others	4 others
CodeWarrior Professional 2.0	520	0	1	5	0	8
JBuilder Client/Server Suite	515	0	2	6	2	9
Sun Java WorkShop 2.0	517	0	2	5	1	9
Sybase PowerJ Enterprise 2.1	504	11	4	8	2	5
VisualAge for Java 1.0	456	55	11	6	1	5
Visual Café for Java 2.1, Database Development Edition	503	8	6	6	2	9

Common failures are more acceptable.

TABLE 2: JVS EXPRESSO TESTS

Compiler	Tests passed	Failures in common with:				
		No other compiler	1 other	2 others	3 others	4 others
CodeWarrior Professional 2.0	2,200	1	0	96*	0	0
JBuilder Client/Server Suite	2,297	0	0	0	0	0
Sun Java WorkShop 2.0	2,200	1	0	96*	0	0
Sybase PowerJ Enterprise 2.1	2,297	0	0	0	0	0
VisualAge for Java 1.0	2,269	28**	0	0	0	0
Visual Café for Java 2.1, Database Development Edition	2,201	0	0	96*	0	0

* The compiler failed these tests because of a shift-and-assign bug.

** These tests caused VisualAge for Java to hang.

Common failures are more acceptable.

links back to the source code.

Unique to WorkShop (and new to this version) is Profiler, a performance analyzer. With this tool, you can easily identify bottlenecks in a Java applet, application, or Bean. After analyzing the performance during runtime, you can view the gathered information. The data can be viewed statistically or graphically and can also be saved for later comparison. JDK components can be filtered out of the statistics or graph in order to concentrate on the modules you can modify.

The Project Manager lets developers have all their projects readily available, and you can define subprojects. But you can work on only one project at a time. Team development is facilitated via native support for the most popular version-control systems, such as PVCS. Other file system-based version control systems can also be used.

The program's Source Browser shows files within a project and classes within files. Files can have URL addresses instead of local file paths, letting you publish directly to Web sites. The types of projects that can be created are applets, stand-alone applications, packages, and Java-Bean components.

Java WorkShop 2.0 gives the serious Java developer such visual niceties as the GUI Builder, support for multiple platforms, remote debugging, and performance analysis. But you still need to write a lot of code with Java WorkShop, making it worthwhile only for those with in-depth knowledge of the JDK event model and JDBC.—*Todd E. Columb*

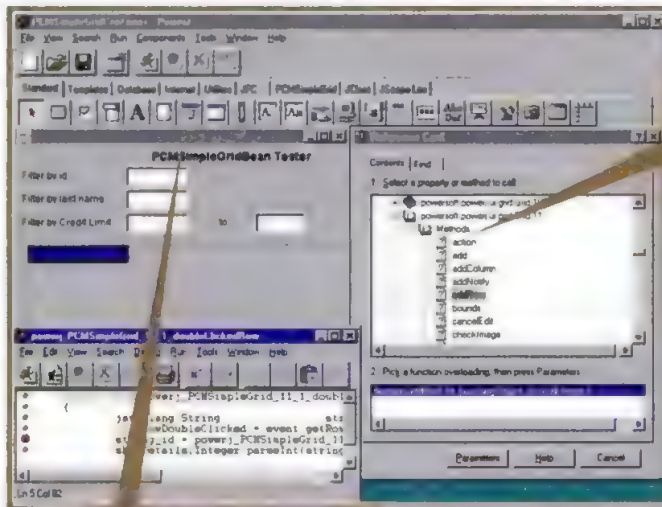
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Sybase PowerJ Enterprise



Featuring the best extensibility, flexibility, and power available on the market today, Sybase PowerJ Enterprise 2.1 (\$1,999 list) should be the package of choice for those interested in enterprise-level Java development and those who need to learn Java as they produce powerful applications. PowerJ's unique ability to plug in any new JDK revision, CORBA and ActiveX component tools, and support for enterprise JavaBeans show off how it keeps your development options open. The tightly integrated development environment with drag-and-drop program-



which component palettes to display, and you can easily add new Beans to the palettes.

ming is consistent with Sybase's database and client/server development products, making the tools very approachable.

PowerJ's drag-and-drop programming feature is especially impressive. Its powerful Reference Card uses introspection to gather methods, properties, and command syntax for any Bean it creates or imports.

As we developed our test applications, we simply dropped a Bean into a code-editor window and the Reference Card displayed available actions for that Bean, including code samples. Then we selected the properties and methods we wanted and the Parameter Wizard walked us through filling in the blanks. Meanwhile, the relevant commands appeared in the code window.

The Reference Card is an invaluable tool for learning the ins and outs of the

language for the Java novice and is a marvelous time-saver for an experienced hand. Though you can bypass the Reference Card and write raw code, we're not sure why you'd want to give up the significant reduction in development time.

PowerJ showcases its extensibility in its handling of the JDK. You can simply plug in the latest JDK version and avoid numerous point-release updates to the software to get your applications to work with the latest standard. Those who need to create a JDK 1.02-compliant application can choose to conform to the earlier standard. In case you ever need to convert a Version 1.02 component to JDK 1.1, PowerJ provides a one-step option to make the switch.

PowerJ's interface is based on Sybase's Power++ environment, which combines robust tools for power-hungry programmers and comprehensive wizards for beginners who want to learn as they go. The interface is highly configurable: You select which component palettes to display, and you can easily add new Beans to the tabbed-page palettes. Missing is a graphical hierarchical class view as found in IBM's VisualAge, with the ability to see inheritance between classes.

The wizards guide you through everything from creating forms, classes, and Beans to choosing a target type for your application. You do have to run the Class Wizard to create a BeanInfo class. We'd prefer to see the BeanInfo generated automatically when you import a Bean, as with JBuilder and VisualAge.

For Java enterprise development, PowerJ comes with the Adaptive Server Anywhere and the PowerDynamo Web Server for testing database connectivity and Web applications. Though you can use COM, CORBA, or RMI for distributed applications, you can also use Sybase's powerful JavaBean-compliant transaction server, Jaguar Component Transaction Server (CTS), also bundled with PowerJ.

Jaguar CTS's simplicity belies its power. You get excellent transaction processing, database caching, and scalability, and you don't have to learn another standard to develop for Jaguar CTS. You merely select the Jaguar CTS target type when creating

gathers methods, properties, and command syntax for any Bean.

an application and PowerJ packages the application as a Jaguar CTS component, creating all the connection code for you. Tight integration with PowerJ and compliance with the JavaBean event model and properties make Jaguar CTS an ideal choice as a middle-tier transaction server.

Database connections in PowerJ are executed through straight JDBC or Sybase's own excellent optimized Type IV JDBC driver, jConnect. Drivers from Visigenics and XDB are also included. This integrated middle-tier component gives PowerJ a distinct advantage over JBuilder.

The Visual Query Editor creates all

the necessary forms and components you need to make a data connection object and also offers value-added events such as batch queries using client-side caching, off-line updates, and cursor events. These features, used in conjunction with Jaguar CTS, offer better performance and greater flexibility in dealing with transactions and rollbacks.

Once the data connection is established, almost any control can be data-bound. In our test database, we bound an image control to a data field, so each time the data changed, the appropriate image loaded automatically. You can also bind nonvisual

controls to items such as query objects.

Though PowerJ is easy to use, it also appeals to experienced programmers, letting you bypass the wizards and work strictly from code windows, unlike some parts of Visual Café. When coding, you can view all the code or limit the code window to a single event-handler function. This helps you stay focused when working on components with lots of code.

PowerJ manages all the code for you behind the scenes—if you delete a method from any window, PowerJ finds and removes all the code related to that method. For programmers doing a lot of develop-

Preview: Microsoft Visual J++

The upcoming version of Microsoft Visual J++ is a clear indication of Microsoft's commitment to Java, though as might be expected, it will apparently be best suited for developing Java applications for the Win32 platform. In case you do need a 100% Java-compatible solution, the next Microsoft Visual J++ can still accommodate you.

We had the opportunity to preview Visual J++ in a private beta, Technology Preview 1. The public beta, expected around the time you read this, will likely go beyond the scope of features here.

Microsoft has done an admirable job with the product, making tremendous advances over Visual J++ 1.1. The first thing that jumps out is the outstanding IDE, taking elements from both Visual Basic and Visual Studio 97 to create a powerful and easily customizable environment.

The improved interface lets you truly customize your layout within the IDE. An impressive feature called Tab Link goes beyond dockable windows, allowing you to tie multiple windows together in a tabbed layout or pull them back out as needed, making the most efficient use of your screen real estate. A built-in Task List scans your code for TODO comments and provides at-a-glance information on what remains undone within your project.

The package's form designer borrows from the Visual Basic model and proves as easy to use. The Properties

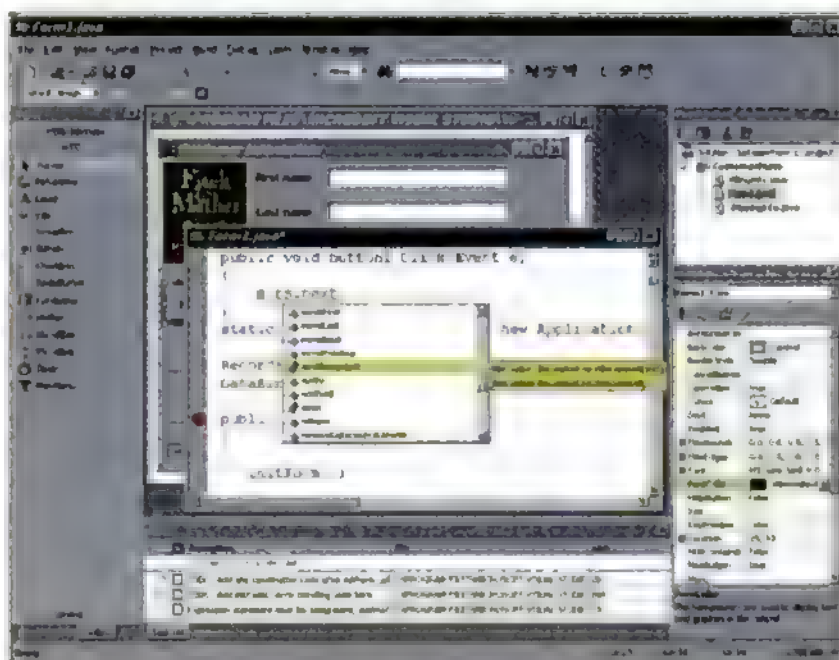
window gives you not only a graphical means of viewing and changing your components' properties but also a means of rapidly adding event code. All of the events associated with the component are listed on a separate tab, and each event has a drop-down list from which you can select procedures

Foundation Classes (WFC) for Java framework that will be introduced with this product, you should have all the power you need to meet all your Java needs. Within this framework, Microsoft has created an excellent RAD tool with rich encapsulation features that allow easy access to graphics and a simple method for data binding.

But the major improvement evident in the next version of J++ lies in its ability to create true server-side Java. The use of the WFC framework makes this possible by giving the developer a way to dig into the Win32 layer directly from Java and take advantage of the native power of the OS. You can now add accelerator keys to your controls, access the hard disk, and hook into the entire

Win32 API for use in your application—while still writing your code in Java.

The strengths of this product favor Windows-based solutions, which will not please Java purists. But if your primary concern is Windows, the next generation of Microsoft J++ may shape up to be the solution for you.—HHH
Microsoft Visual J++. List price: Not yet determined. Microsoft Corp., Redmond, WA; 800-426-9400, 425-882-8080; www.microsoft.com. Choose 516 at www.pcmag.com/infolink.



The new Visual J++ has an updated interface and Windows-specific Java features.

that are currently available in your component. This makes it easy to point several components to a common piece of code with no additional work.

A robust two-way programming feature lets you work in the visual environment and the code window simultaneously. The visual designer freezes the code it is using and lets you change any other piece of the code without closing the designer.

This is far more than an interface improvement. With the new Windows

ment, PowerJ lets you save any application as a template for creating new ones.

The integrated, in-context debugger lets you debug in an applet viewer or a browser. As with VisualAge's debugger, you can display various watchers and inspectors while stepping through the code. To help solve coding problems, error messages appear with the offending line in the code window along with possible solutions—again, a tremendous advantage for beginners not used to troubleshooting code and a great time-saver for experts. If you do get stuck, the

context-sensitive help is superb. You also get more than 60 application samples on the CD-ROM and an excellent programming textbook, in case you want to delve further into the Java language.

With its rare combination of power and ease of use and such features as the unique Reference Card, PowerJ will appeal to experts and novices alike.—*Greg Alwang*
Sybase PowerJ Enterprise 2.1. List price: \$1,999. Sybase Inc., Emeryville, CA; 800-879-2273, 510-922-3555; fax, 510-922-3446; www.sybase.com. *Choose 513 at www.pcmag.com/infolink.*

IBM Corp.

VisualAge for Java

Seasoned object-oriented programmers looking at Java will find IBM's VisualAge for Java 1.0 (\$1,995 list) to be a complete solution, especially if you need enterprise connectivity. The project-oriented repository aids developers looking for control and built-in version tracking, while the strong visual programming and debugging features are the most sophisticated in this roundup. All this power comes at a price, though: VisualAge is a challenging package

Preview: SuperCode for Java 2.0

Though the product was still in private beta, we got a sneak peek at SuperCode for Java 2.0 Professional Edition. We found that it offers an attractive array of features that will likely make it one of the better Java tools, particularly for using Java on the Microsoft Windows platform. Excellent support for ActiveX and JavaBeans, strong interactive debugging, and native code deployment are its most notable features. A lack of enterprise-level features will limit its appeal, however.

The SuperCode programming environment stresses a RAD component programming style with wizard support for basic development tasks. Projects can contain both Java and C/C++ code, making this a natural fit for programmers who want to use legacy code within Java. With SuperCode, you can target native-code Intel EXEs and DLLs as well as Java .class and JAR files.

The most noteworthy feature here is the ability to import ActiveX controls into the SuperCode environment and use those controls alongside JavaBeans and AWT components. ActiveX controls are actually "wrapped" as JavaBeans to make this happen. The visual designer lets you work with components of both types, allowing you to set properties and add events. SuperCode offers true support for JavaBean customizers, which can assist developers in working with Beans.

The visual designer is generally capable and lets the developer work in

actual pixel coordinates or "grid-bag" layout dimensions. This ability makes it easier to design applets that look correct in browsers, for instance.

For database support, SuperCode bundles more than a dozen data-aware controls, from simple input fields to image controls and grids. The components use higher-level classes that connect to databases using JDBC. ODBC

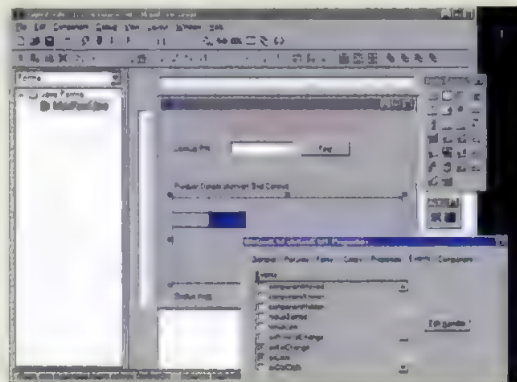
debugging is entirely interactive, and you can view changes to source code.

Besides basic watches and breakpoints, the debugger includes several nifty features such as a *pop*, which allows you to call the stack through function calls and fast conditional breakpoints. Because of the cross-language support, we also had no problem stepping through Java and C++ within the same program.

In order to deploy Java applets or applications, you extract them in SuperCode to Java byte code in JAR files or native-code EXE files. The SuperCode package includes its own redistributable, native-code Java virtual machine. The alternative is to generate generic JDK 1.1.4-compliant executables in JAR files.

Judging from this preview edition, the new version of SuperCode will be a sturdy

development tool with excellent RAD component capabilities, innovative debugging, and good native-code deployment capabilities. It's an appealing solution, especially for developers who want to mix and match ActiveX, C++, and Java code.—*RVD*
SuperCode 2.0 for Java Professional Edition. List price: \$999 (free upgrade for Version 1.2 users). SuperCode Inc., Bellevue, WA; 800-448-6543; www.supercode.com. *Choose 517 at www.pcmag.com/infolink.*



SuperCode lets you use ActiveX and JavaBeans controls in the same programming environment.

drivers are included for major database vendors. A capable form wizard let us sail through the database portion of our tests, though this feature wasn't quite finished in the beta we previewed.

Once you design an application, you can run and debug it with SuperCode's exceptional debugging capabilities. SuperCode builds a memory image of your executable in order to debug it. The program saves it to memory and waits for your command to compile. The advantage here is that

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to learn, and even experienced programmers will face a significant training period. Overall, either JBuilder or PowerJ would offer a better balance of power and ease.

VisualAge's visual programming technique lets you arrange and connect JavaBean objects in a Visual Composition Editor. Once you master the various connections (event-to-method, parameter-from-property, and so on), building a connection is as simple as drawing lines between objects and defining the properties of the connections.

Visual programming at this level does not totally eliminate the need to write raw code, but it helps you get to the end result much quicker: The program generates a lot of complex connection code for you. This is extremely useful when it comes to defining elaborate data-access connections, and it can save you from having to do a huge amount of manual coding.

Further, VisualAge for Java adheres strictly to the JDK 1.1 Bean event model, making it ideal for both creating JavaBeans and consuming existing ones that

you want to integrate into your application. In our testing, we easily extended an existing panel Bean to create our grid Bean using the Visual Composition Editor. We visually created the event stub code we needed, so all we had to provide was just a few lines of code within each event to identify specific functionality. We also added a custom property editor in the form of a list box for text justification in the grid in our test application. This helps make distributing comprehensive Beans to other developers a real snap.

SUMMARY OF FEATURES

See www.pcmag.com for interactive views

Java Development Packages

	CodeWarrior Professional 2.0	JBuilder Client/Server Suite	Sun Java WorkShop 2.0	Sybase PowerJ Enterprise 2.1	VisualAge for Java 1.0	Visual Café 2.1, Database Development Edition
■ YES ■ NO						
List price (enterprise edition)	\$449.00	\$2,495.00	\$125.00	\$1,999.00	\$1,995.00	\$499.95
Development Environment						
Context-sensitive help	■	■	■	■	■	■
Wizards or equivalents	■	■	■	■	■	■
Third-party program launch from IDE	■	■	■	■	■	■
Includes JIT compiler	■	■	■	■	■	■
Supports Sun compiler	■	■	■	■	■	■
Can deploy JIT/VM	■	■	■	■	■	■
Editor						
Syntax highlighting	■	■	■	■	■	■
Remappable keys/macros	■	■	■	■	■	■
Programming Tools						
Wizards can add control events	■	■	■	■	■	■
Class browser	■	■	■	■	■	■
Can browse uncompiled projects	■	■	■	■	■	■
Visual class designer tool	■	■	■	■	■	■
GUI resource designer	■	■	■	■	■	■
Can attach code to controls in resource editor	■	■	■	■	■	■
Includes HTML editor	■	■	■	■	■	■
Supports ActiveX	■	■	■	■	■	■
Can create ActiveX in Java	■	■	■	■	■	■
Consumes/targets JavaBeans	■	■	■	■	■	■
Provides classes for database connectivity	■	■	■	■	■	■
Debugging						
Integrated debugger	■	■	■	■	■	■
Can debug in browser	■	■	■	■	■	■
Debugger catches Java exceptions at the offending lines	■	■	■	■	■	■
Breakpoints/Watch variables	■	■	■	■	■	■
Popup watches	■	■	■	■	■	■
Data tips	■	■	■	■	■	■
Step/Trace	■	■	■	■	■	■
Supports multithreaded debugging	■	■	■	■	■	■
Supports remote debugging	■	■	■	■	■	■
Integrated source control	■	■	■	■	■	■
JavaScript debugging support	■	■	■	■	■	■
Supports HTML debugging	■	■	■	■	■	■
Publishing						
Can create JAR/ZIP files	■	■	■	■	■	■
Can upload projects to the Web	■	■	■	■	■	■
Compiler optimizations	■	■	■	■	■	■
Cross-platform host (IDE)	■	■	■	■	■	■

Once a Bean is created or imported, the BeanInfo tab gives you immediate access to all its properties. You can specify which properties to promote and which to hide, letting you freeze certain properties or provide specific flexibility when reusing Beans. This method proved more powerful and effective than that of PowerJ, which required us to run the Class Wizard in order to create a BeanInfo class.

Though you have many ways of getting to the elements of a project, the interface (based on VisualAge for Smalltalk) is not as intuitive as that of JBuilder or Visual Café. It consists of tabbed pages and various browser and explorer screens for viewing and managing the components of an application. You do have Smart-Guides to walk you through everything from creating applets to building enterprise connections, so you don't need to master the entire interface before beginning to work.

A powerful Repository manages all editions of your projects, packages, classes, and interfaces. Code is not saved directly to files but is cataloged in the Repository database. This encourages an organized development environment by keeping all the necessary project components together and by automatically versioning your code.

Any code that is current is placed in the VisualAge Workspace and made immediately accessible. Past editions of components can be reinstated from the Repository and additional class libraries can be imported to the active Workspace if needed. Managing code is easy, but you can't see separate pieces of code unless you export them out of the Repository.

For setting up database connectivity, VisualAge connects directly to any JDBC database and creates distributed RMI connections with minimal coding. Its Data Access Builder guides you

through creating JDBC connections and table mappings, and you can extend them by using SQL rules and limits when reusing the connection Beans. If you need to connect to legacy and existing systems, VisualAge includes wizards for connecting to CICS (Customer Information Control System) transactions and C++ DLLs. VisualAge data connections support transaction processing, so you can include complex and secure data updates in your applications.

To create distributed Java applica-

tion, you use VisualAge's RMI Access Builder. This wizard creates the necessary code for server proxies, which makes Beans accessible in the distributed client/server environment. Using this method, you can quickly convert a local Bean into a server Bean and let VisualAge write all the complex RMI calls for you.

Once the server Beans are created, you use VisualAge's Remote Object Instance Manager to run the server Beans and monitor the threads and execution progress. Using this tool, it is very easy to convert a client-side application into a distributed application without having to code the middleware transaction layer. VisualAge is limited to support for RMI, though, whereas PowerJ supports CORBA, RMI, and others as part of its middle-tier solution.

The debugging environment in VisualAge is replete with features. As in Visual Café, VisualAge's on-the-fly debugger lets you change code and resume without

halting the application's execution. The incremental compiler takes care of recompiling only the modified code.

Since VisualAge for Java has an integrated (though nondistributable) Java VM, we were able to see our animation example in action right in the development environment without having to compile and run the code repeatedly until we got it right. If you do make any coding errors, they're automatically trapped and kept on the Unresolved Errors tab for easy access by anyone on the development team.

The Scrapbook is a slick programming window that lets you test specific code blocks in the context of any class without having to run the entire applet in an applet viewer. It includes debugging features, such as the ability to spawn an Inspector window for tracking values throughout execution. We even

used it as a handy syntax checker when typing complex lines of Java code.

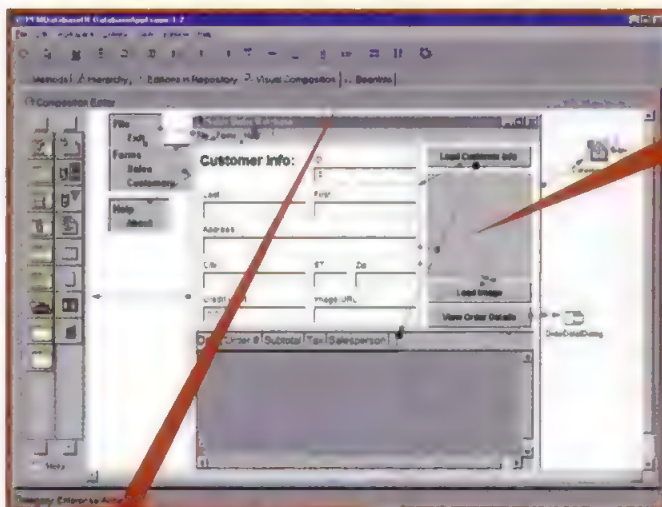
VisualAge has a lot to offer Java developers, with its sophisticated RAD environment and advanced debugging features. Its initial learning curve is steep enough, though, to give all but experienced users of the product pause.—GA

VisualAge for Java 1.0. List price: \$1,995. IBM Corp., Armonk, NY; 800-426-3333; www.software.ibm.com. Choose 514 at www.pcmag.com/infolink.

Symantec Corp.

Visual Café for Java, Database Development Edition

Making Java technology accessible to a broad range of developers, Visual Café for Java 2.1, Database Development Edition (\$499 list) is a strong product that will meet the needs of all but the most demanding programmers. You can do enterprise-wide Java development, but Visual Café ultimately lacks the flexibility and power of JBuilder and PowerJ, both of which support CORBA in addition to RMI for distributed computing. You must use a wizard for almost every function, and the program inserts proprietary code when using introductory wizards, which limits your ability to



VISUALAGE FOR JAVA
BeanInfo Tab gives you access to all Bean properties. You can specify which properties to promote and which to hide.

THE VISUAL
Composition Editor lets you visually define complex connections between objects on forms.

make changes to the code later.

Visual Café's IDE is both comfortable to use and a little confusing. You get all of the detail you need—but not necessarily at a glance. We found it was very easy to get lost in the jumble of windows open on the screen while working on a project. The three-pane class browser is well thought out, but it's not always present on the screen, unlike JBuilder's application browser window.

The IDE, though seemingly chaotic at times, does have a lot to recommend it. The entire IDE supports drag-and-drop, making it very easy to import existing code, negotiate tools, and navigate through the entire project. We were able to use Notepad to write a simple JavaBean and add it to our project by dragging it across from Windows Explorer. Visual Café was immediately able to expose the properties and methods of our Bean, and we were able to use it with no further customization.

The Hierarchy Editor is an excellent feature, providing a graphical representation of the entire class hierarchy within your project. What makes this tool stand apart is that it truly is a full-featured editor. Subclassing within the editor is done via a simple drag-and-drop procedure, and a wizard guides you through exposing properties and methods of the parent class. It then creates a code stub consisting of the basics required for compilation—and all of this is ready for use immediately.

The visual designer extends the power of the IDE, providing powerful RAD tools to make interface development simple. The program provides a large library of Beans, giving you immediate access to most any component you might need, and a well-designed properties window lets you change settings quickly at design time.

One of the best features in the visual environment is the Interaction Wizard, which is used to wire components together visually within the JDK 1.1 event model. VisualAge has a similar, more powerful feature than the one in Visual Café, but we found the one here easier to use than the one in VisualAge. Using the

wizard to draw a line between components brings up a dialog box that provides access to the event and resulting action. With just a couple of mouse clicks, you have implemented the entire event without writing a single line of code, even if you have no core understanding of the JDK 1.1 event model.

Visual Café provides a powerful set of tools for providing database connectivity. This can be accomplished via the included dbAnywhere Server, which offers a strong middleware solution for accessing a wide variety of databases (including the

Bean. You can decide what kind of Bean you need to create, which methods and properties to expose from its parent classes, and what you need to custom-build. The wizard generates only stub code for the Bean, leaving you to fill in the blanks. You need to be prepared to write a lot of advanced Java code to complete the Bean, but the skeleton is ready to compile.

Deploying the Bean once you have built it is easy with the product's AutoJAR feature, which lets you quickly create a JAR file and import it into a project

immediately. If you find that you need to make a change to the Bean, running AutoJAR again will make your changes live in any open projects in which your Bean has been implemented.

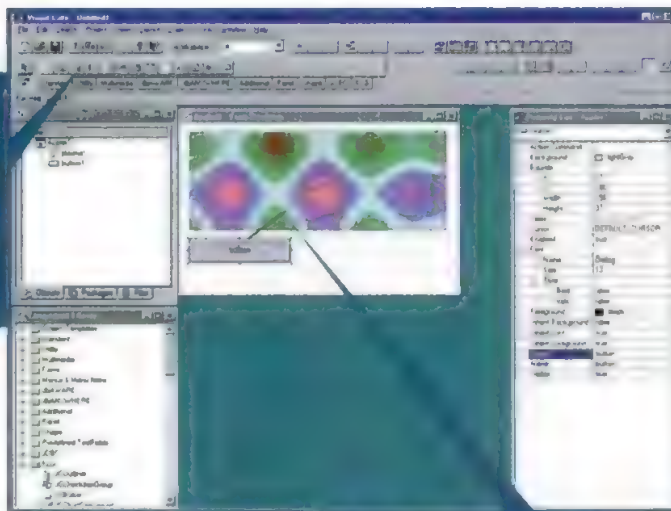
Visual Café's debugger is quite powerful. You can debug from within the applet viewer, Internet Explorer, or Netscape Communicator without sacrificing functionality. A set of debugging tools let you set watches, monitor threads

and calls, step through your code, and evaluate expressions immediately. Visual Café also supports incremental debugging, letting you make changes to your source code and testing your changes on the fly while your program is running.

You also get support for version control, native code compilation, and RMI, with little additional work. Though not as flexible as other packages, Visual Café still delivers a strong product that will meet the needs of most programmers. This is an addition to your Java toolkit that is well worth considering —HHH

Visual Café for Java 2.1, Database Development Edition. List price: \$499. Symantec Corp., Cupertino, CA; 800-441-7234, 408-253-9600; www.symantec.com. Choose 515 at www.pcmag.com/infolink. PC

VISUAL CAFÉ includes a set of data-aware JavaBeans, making data connections easy.



THE INTERACTION wizard lets you draw a line between two components and gives you the logic for the interaction.

Sybase SQL Anywhere database that's bundled with the product), or directly through JDBC. A set of data-aware Beans is provided, and templates and wizards for data-aware projects walk you through getting the application built. A window in dbNavigator lets you drill down into your database at any depth.

Extending the drag-and-drop paradigm, you can add a data-enabled field to the visual designer by simply dragging it from the dbNavigator. Setting up master/detail relationships is just as easy, and you can build complex relationships without a lot of core SQL programming. Symantec lets the RAD tools do most of the work, making it possible to wire an application together almost effortlessly.

As expected, creating a JavaBean was more challenging than creating an applet or application. Visual Café's JavaBeans Creator Wizard gets this process started for you by guiding you through each of the major steps in creating your

Net Tools



No Time *for* Downtime

Clustered servers insure that a downed server will not greatly affect access to your mission-critical applications.

By Tony Pompili

Last year, Microsoft introduced its long-awaited clustering software Microsoft Cluster Server (MSCS) with the promise of lower-cost, higher-availability computing based on the popular Microsoft Windows NT Server 4.0, Enterprise Edition. After waiting patiently in the wings, a handful of PC server vendors have burst onto the stage with repackaged versions of their popular server platforms and introduced Microsoft-certified cluster server packages. By basing their solutions on typical server components such as SCSI

for sharing disk subsystems, Fast Ethernet adapters for sensing failover, and standard Pentium Pro and Pentium II chip sets, vendors are hoping to attract buyers to the world of higher-availability computing. These early results indeed confirm that MSCS (code-named Wolfpack) is encouraging cluster solutions from vendors with prices previously unheard of in the traditional PC cluster world, where clustered systems typically cost between \$100,000 and \$200,000. (See "Clustering on a Budget" in this issue.)

The four clustering solutions reviewed here—

INSIDE

CLUSTERED SERVERS: Once Microsoft took the wraps off Microsoft Windows NT 4.0, Enterprise Edition, which supports two-node clustering, PC vendors rushed to market with cluster server packages. Contributing editor Tony Pompili and contributor Steven Chan find these low-cost solutions offer high availability—and in some cases bulletproof fault tolerance—but still lack cluster-specific management utilities.



WINDOWS NT FIREWALLS:

Acknowledging the continuing importance of Internet security, contributor Robert Lipschutz looks at the latest Windows NT-based firewalls from Cisco and Network-1. Both companies have added some handy bells and whistles—such as tighter integration with Windows NT's user and group domains and multi-protocol support—that make their products stand out from the crowd. *Page 229.*

CLUSTERING ALTERNATIVES:

Although Microsoft Cluster Server is getting most of the ink, it isn't the only low-end clustering solution around. Tireless Tony Pompili



takes a look at cluster products such as Novell's NetWare SFT III and Tandem Computers' NonStop Clusters. *Page 235.*



the Data General AViiON NT Cluster-in-a-Box, the Dell PowerEdge Cluster, the Digital Server 3200 and Digital RAID Array 310, and the HP NetServer LHII with AutoRAID—each sell for well under \$100,000. Only Dell, however, includes installation and configuration in the solution price. Tandem Computers, recently acquired by Compaq, was not included in this roundup, because the company does not offer a two-node cluster solution. We also did not include Compaq because it could not provide us with a solution in time for our story.

Clustering is not a new concept for the PC market. Companies such as Digital Equipment Corp. and Tandem have long provided Windows NT Server-based clustered solutions that run such mission-critical programs as online transaction processing (OLTP) financial applications and database programs where downtime can run into millions of dollars of lost revenues. What Microsoft brings the picture is its steamroller-style clout in getting hardware and software vendors to conform to MSCS. Microsoft plans to beef up the next generation of MSCS. Although a ship date has not yet been announced, the new iteration is expected to support more than two servers and additional subsystem interface technologies, such as Fibre Channel. The next release will also provide application load balancing.

CLUSTER SYSTEMS AT WORK

All of the systems in this roundup ran MSCS successfully. We did not award an Editors' Choice, however, because we found each solution lacking in support and management software. On our failover tests, all the systems took about the same time, from 24 to 28 seconds, to fail over and reconnect their clients. When we downed a server while attempting to open a Web page through IIS, the browser simply appeared to be waiting for a slow Web server. When IIS failed over, the client immediately reconnected: MSCS is impressive.

MSCS cluster hardware vendors all must be certified by Microsoft as adhering to a basic-system MSCS configuration. The key system component is a shared SCSI hard disk subsystem. (Microsoft promises to expand support to other technologies, such as Fibre Channel.) With two systems taxing a common bus and sometimes array controllers as well, the subsystems could prove to be a performance bottleneck for a clustered solution. We also looked at the ease of installation and management of these complicated subsystems.

Knowing that application failover isn't the only important failover feature for a clustered system, we looked at the built-in redundancy and fault-tolerance capabilities vendors offered beyond the basic MSCS specifica-

tions in their systems.

On the software side, we were particularly interested in the types of value-added cluster monitoring and

management tools that came with the systems. This and other areas of software proved disappointing. For the most part, we found little new. Most of the products came with server management software, such as HP Open View, for centrally monitoring the most vital server components including processor and disk drives, but we were disappointed that the solutions didn't include software specifically designed to manage and monitor clusters. HP, however, showed us a beta version of its impressive management product ClusterView, which lets you view the status of Microsoft clusters.

Providing management tools isn't just a problem for hardware vendors. Few applications currently are cluster-aware. Of course, many of applications in Microsoft BackOffice, such as IIS and SQL Server, can work with MSCS to tell the clustering software when a problem occurs. Other software vendors, such as Cheyenne, Computer Associates, and Oracle have promised actual cluster-aware applications and are slowly beginning to deliver them. As for the bevy of other server applications, we'll have to see how quickly they adapt their code to MSCS. Until then, MSCS is primarily a niche solution for Windows NT.

That's not to say that you won't find a gem in our collection of MSCS-based solutions. The more you pay, the more you get. If pricing is important to you, then consider solutions from Dell and Digital. Each of these systems, based on dual Pentium II processors, can be configured in a two-server setup for less than \$50,000, about \$20,000 less than the HP NetServer and \$30,000 less than the Cluster-in-a-Box. Of course, with Hewlett-Packard Co. and Data General Corp.'s products you get faster, more robust disk subsystems with greater scalability features, plus bulletproof fault tolerance, particularly with the DG solution. And their prices are still pretty amazing compared with the \$100,000 to \$200,000 you generally have to shell out for a clustering solution.

So if you're ready to start hosting your mission-critical applications, whether database, messaging system, or Web server, the vendors in this roundup have a good set of generally inexpensive solutions to get you started—though we don't think any of this will be useful to your organization until more MSCS cluster-aware applications become available. We also would like to see the vendors integrate better MSCS monitor-

Net Tools

CLUSTERED SERVERS

SUMMARY OF FEATURES

Clustered Servers

	Data General AViiON NT Cluster-in-a-Box	Dell PowerEdge Cluster	Digital Server 3200 and Digital RAID Array 310	HP NetServer LHII and AutoRAID
■ YES ■ NO				
List price of tested configuration	\$87,421	\$45,603	\$28,254	\$61,216
Server				
Maximum number of processors	Four Pentium Pro/200s	Two Pentium II/300s	Two Pentium II/266s	Two Pentium II/300s
Maximum installable RAM	4GB	512MB	512MB	512MB
Expansion-bus slots	4 PCI, 4 PCI/EISA	5 PCI, 3 ISA	2 PCI, 4 EISA, 1 PCI/EISA	4 PCI, 4 EISA, 1 PCI/EISA
Network adapters	One 10/100 Osicom	Three Intel 10/100 Pros	One SMC 9432TX	Three NetServer 10/100TX PCs
MSCS SCSI adapter	Adaptec 2944UW	PowerEdge Expandable RAID Controller (PERC)	Adaptec 2944UW	Adaptec 2944UW
Maximum node-to-cluster distance	3 meters	4 meters	25 meters	25 meters
Disk Array				
Name	Clarion	PowerEdge Scalable Disk System 100	Digital RAID Array 310	HP AutoRAID 12H
Hard disks	Ten 4GB	Eight 4GB	Seven 2.1GB	Two 9.1GB, ten 4GB
RAID controller	Mylex (optional)	PERC	Part of Digital RAID Array 310	HP AutoRAID 12H
RAID levels supported	0, 1, 3, 5, 10	0, 1, 5, 10	0, 1, 0+1	5, 0+1
Software				
Windows NT 4.0, Enterprise Edition, included	■	■	■	■
Vendor's clustering configuration software	None	None	Digital Clusters for Windows NT	HP ClusterView for Windows NT

ing into their standard management and monitoring tools. On the whole, though, if you want to get your feet wet with higher-availability systems, there's never been a better time.

Data General AViiON NT Cluster-in-a-Box

If you're looking for a bulletproof Wolfpack cluster, then consider the Data General AViiON NT Cluster-in-a-Box. Equipped with dual-everything, including Data General Corp.'s high-performance Clariion RAID-based disk subsystem, the Cluster-in-a-Box is designed to accommodate Windows NT as it carves out a place in the OLTP world and becomes a trusted venue for mission-critical applications. Though at \$87,421 this is the priciest solution in our roundup, DG's Windows NT cluster delivers a degree of fault tolerance that's just not available in any of the other products we looked at.

Built around two 200-MHz AViiON 3650R servers, the AViiON line includes both Intel and RISC-based processors. DG also offers the Cluster-in-a-Box in a RISC-based Unix version. Of course, Windows NT can run only on an Intel processor. The Cluster-

EDITORS' CHOICE

• No clear winner



Each of the clustering solutions that we tested had its strengths, but the differences in the way they handled certain tasks were insignificant. All four fell short

when it came to cluster-aware management capabilities. Hewlett-Packard did offer a beta version of ClusterView, a cluster-specific management utility. With no clear Editors' Choice, we selected two honorable mentions.

First, Dell Computer Corp. gets a nod for the cluster-specific features—like dynamic termination of the Scalable Disk System disk array—included in the Dell PowerEdge Cluster (\$45,603 list). It's noteworthy that the price covers planning, configuration, and testing, as well as Mi-

crosoft certification at the customer site.

Also worth your consideration as a high-end solution is the Data General AViiON NT Cluster-in-a-Box. Although a hefty price tag (\$87,421 list) makes this the costliest product we put to the test, Cluster-in-a-Box is fast becoming a respected alternative for mission-critical applications, particularly in the online transaction-processing market. The level of fault tolerance offered by the Windows NT version of Cluster-in-a-Box is superior to any other solution we reviewed.

in-a-Box we reviewed had four processors, though DG has recently announced an eight-processor version, the AV 8600, which could be a potential powerhouse for CPU-intensive applications. The Cluster-in-a-Box also uses DG's popular Clariion disk subsystem. Built for speed and reliability, this box comes preconfigured with impressive N+1 dual-storage processors and mirrored write cache as well as hot-swappable drives. It's built on the N+1 concept, in which a RAID and hotspare are included in the same array, and almost any component in either the drive subsystem or the servers can crash without bringing down the system. The Clariion is so well respected in the industry that it is resold by many third-party vendors as a high-performance, fault-tolerant subsystem option.

We couldn't have asked for an easier installation. The entire Cluster-in-a-Box comes preconfigured. (DG will configure the hardware on-site.) The box is preassembled, including built-in video and a keyboard switch. We dropped it into a refrigerator-size cabinet, plugged it into our network, and powered it up; we were then ready to install Wolfpack. Software installation was equally painless. With Windows NT and MSCS executables already on the hard disk and DG's clear, step-by-step instructions, it took us little time—about 45 minutes—to get this system up and running as a Wolfpack cluster.

The obvious difference between the Cluster-in-a-Box and other products reviewed

here, including the Dell PowerEdge Cluster and the Digital Server 3200 and Digital RAID Array 310, is the attention DG has paid to hardware fault tolerance. The solution features two of most things and three of some things. Each of the two systems has an Osicom 2340 Multiport 10/100 adapter that allows up to four network connections on a single adapter. On the power side, the system has three 350-watt hot-swappable power supplies, and the cabinet has two independent power supplies. The power source is a 220-volt line, and though this is an oddity for PCs, DG thinks it's not a problem for server rooms, since most can accommodate both 120-volt and 220-volt lines. For greater capacity, the AV 3650R also comes with dual-PCI buses. Though we found it couldn't recover from a CPU error on the fly, the AViiON boot software is smart enough to reconfigure itself around a dead processor automatically during reboot.

Although the Cluster-in-a-Box has a built-in SCSI adapter, the shared cluster bus is run on an Adaptec 2944 Ultra-Wide differential SCSI adapter installed on the Avionics PCI bus. The Adaptec connects the AV 3650R to what we think is the most interesting component of the DG Cluster, the Clariion subsystem. For this review, we tested the ten-drive Clariion Series 1000.

Available in capacities from 125GB (for a Series 1000) to 534GB (for a Series 3000), the Clariion is based on a redundant architecture that is virtually bulletproof against hardware



DATA GENERAL provides the most impressive hardware-based fault-tolerant solutions of all the products reviewed.



THE CLUSTER-IN-A-BOX requires a 220-volt power line, which might not be available in some PC-based server rooms.





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failure. At the core of the system are dual storage processors. Basically a front end to the SCSI bus, each processor has access to all buses. Each drive is connected to multiple SCSI buses. Thus, if a bus or processor fails, the host can continue to access the drives. This dual-storage-processor configuration can also work with multiple SCSI adapters in the AV 3650R, although the review units were not configured in this way.

Although Clariion currently supports only SCSI, MSCS is also available in a fiber-channel version.

A step-by-step manual explains everything from how to connect network cables to configuring the disk arrays to walking through the Windows NT and MSCS cluster configuration. It took about 45 minutes to configure the solution. That was very impressive compared with other products, such as the Digital Server 3200/Digital RAID Array 310 system, which didn't even mention Wolfpack in its documentation.

Data General relies on NuView's ManageX console to provide NTAlert and NTerprise Manager for its Windows NT systems. ManageX snaps into Microsoft's new Management Console, expected to ship with Windows NT 5.0. DG has added specific access and notification utilities for its Windows NT servers through the ManageX console. Though the system does not offer any cluster-specific utilities, it is useful for basic system monitoring of the Windows NT hardware and software environment.

The Cluster-in-a-Box is pretty impressive, even though we don't usually think of Data General as a Windows NT system supplier. Clearly the most fault-tolerant of all of the products reviewed here, this box is going to hit your budget a bit harder than some of the others, such as the Digital Server 3200 and Digital RAID Array 310 system. But for those IS shops trying to convince the old guard that Windows NT might just be ready for prime time, the DG solution is a good starting point.—TP

Data General AViiON NT Cluster-in-a-Box. List price: Tested configuration (2 servers, 1 array), \$87,421. Data General Corp., Westborough, MA; 800-328-2436, 508-898-5000; fax, 508-366-1319; www.dg.com. Choose 900 at www.pcmag.com/infolink.

Dell PowerEdge Cluster

For the medium-size to large company looking for a Microsoft clustering solution, Dell Computer Corp.'s \$45,603 Dell PowerEdge Cluster offers some unique cluster-specific components, such as dynamic termination of the company's Scalable Disk System disk array. Most similar to the Data General AViiON NT Cluster-in-a-Box among the systems reviewed here, the PowerEdge Cluster covers the basics of the Microsoft Cluster Server. The Dell product is the only offering that includes in the price—the second-lowest in

Net Tools

CLUSTERED SERVERS

this roundup—the planning, configuration, testing, and validation (Microsoft cluster certification) of the PowerEdge, all done at the

customer's site by Dell or a Dell PowerEdge Cluster specialist service partner. As with the other systems we reviewed, the only thing lacking is cluster management software that goes beyond what Microsoft provides. Intel LANdesk Server Manager 2.52, which comes standard with the PowerEdge,



DELL includes the cost of configuration, testing, and certification by its staff in the PowerEdge Cluster's price.



LIKE the other products here, the Dell PowerEdge Cluster does not come with MSCS-specific management software.

is not cluster-aware.

The unit we tested came configured with two Dell PowerEdge 4200 dual-Pentium II 300-MHz servers, each with 512K of L2 cache and 512MB of RAM, three Intel EtherExpress Pro 10/100 NICs, and two

Microsoft Cluster Server

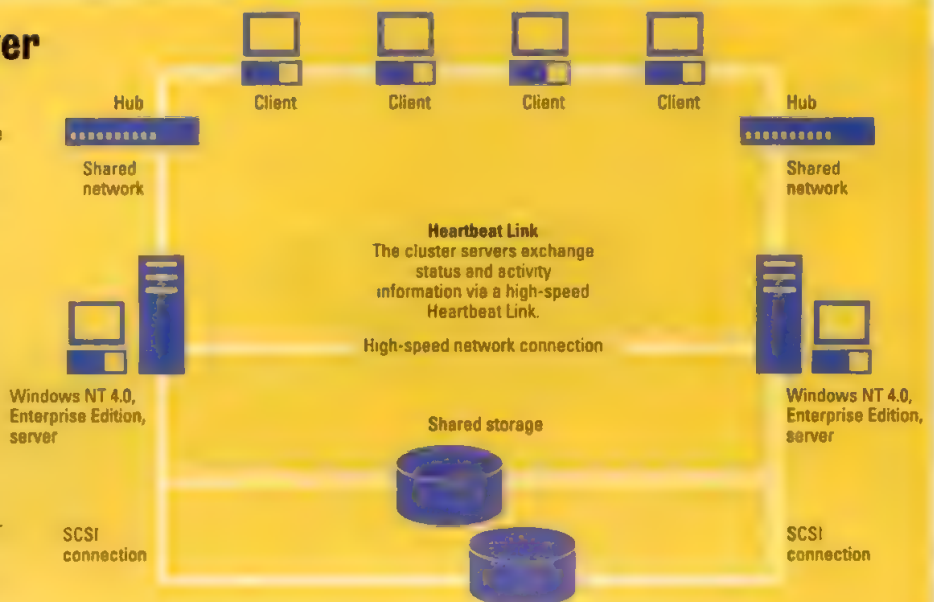
Both servers in a Windows NT cluster appear to network clients as a single entity. When a failure occurs, a client group is moved from the failed server to the other system. A client's access to applications and data stored on the cluster's shared disk subsystem is interrupted only for the duration of the failover.

Applications

Cluster-aware applications can provide failover (automatic transfer to the live server) or fallback (return to service after the server is brought back online). Non-cluster-aware applications must be restarted manually. A cluster API is available for applications development from Microsoft.

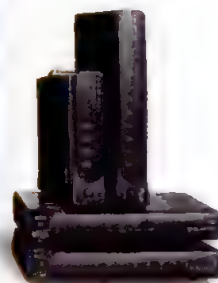
Cluster Management

Microsoft Cluster Server must be installed on both servers within the Windows NT domain and is responsible for all event activity, failure operations, and communications maintenance within the cluster. The Resource Monitor checks for status, including failed, off-line, online, and off-line/online pending, and it reports the activity to the Cluster Server. You can set the time-out values and specify when the cluster will respond to a failure.



A shared external SCSI disk subsystem provides common storage for two servers. Currently, the maximum distance for SCSI connections to clustered servers is 25 meters. SCSI adapters must also pass Microsoft's Cluster Server Hardware Compatibility test.

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PowerEdge RAID Controllers (PERCs). In what Dell considers a fairly standard setup, one PERC was used to control the three internal 4GB hard disks. The other, a special cluster PERC (or CPERC), was connected to Dell's Scalable Disk System (SDS) 100, the external disk array shared by the cluster servers. The SDS 100 held eight 4GB drives, the maximum number for the array. The solution also used a 3Com SuperStack II Switch 3000 TX for the Heartbeat Link. That allows each server to monitor the health of the other. The other solutions reviewed use a crossover cable for the heartbeat interconnect.

The standard PERC and the cluster PERC came with 16MB and 32MB of cache, respectively. Both support RAID Levels 0, 1, 5, and 10. Setting up the cluster's shared logical drives was easy, because we had only to enter the CPERC RAID setup in the RAID controller firmware during the server's boot process, assign each physical drive to a logical drive, and then select a RAID level. The disk

arrays had to be configured identically on both servers.

Each PowerEdge 4200 server supports two CPERCs. And each CPERC can support two SDS 100s, for a maximum of four SDSs per cluster. We like the fact that the chance of a lone SDS 100 becoming a point of failure for the cluster can be eliminated by implementing two SDS 100s in a RAID 1+0 configuration.

Like the other arrays in this roundup, the SDS 100 supports 2GB, 4GB, and 9GB Ultra-Wide SCSI disks. It holds a maximum of 8 disks—only one more than Digital's 7—and doesn't quite offer the breathing capacity of Data General's 10-disk or Hewlett-Packard's 12-disk maximum. Three hot-pluggable redundant cooling fans and dual hot-pluggable redundant power supplies, typical for external disk arrays, add to the SDS 100's resistance to failure. We liked the I2C standard server management bus (SMB) port, which allowed the status of the

SDS 100 to be monitored using Intel LANDesk. This is a nice feature that let us monitor the SDS 100 independent of the servers to

which it was connected. We also liked the fact that both the cluster PERC and the SDS 100 maintain configuration information such as the controller ID, RAID level, number of disks, and stripe size. When we attempted to connect the SDS to the wrong CPERC channel, we were notified during the boot process to check the cable configuration. Unfortunately, the standard PERC is without this capability.

When we connected the SDS 100 to a standard PERC, the cluster hung during the boot process; the Dell server identified the problem as a SCSI ID conflict between the SDS 100 drives and the internal drives on the standard PERC. Since users are likely to make either mistake—connecting the SDS 100 to the wrong cluster PERC or to the wrong standard PERC (which looks identi-

BENCHMARK TESTS

Clustered Servers



The Windows NT clusters in our roundup provided no surprises. In fact, shoppers should consider application type and hardware fault-tolerant options, rather than failover performance, when making a buying decision.

What the Numbers Mean

Our testing scenario reveals insignificant differences among the vendors' products in terms of failover, where small workloads and data are easily picked up and shouldered by the surviving server node of a two-node cluster. Within 30 seconds each clustering system responded to our Web server application for virtually uninterrupted client service.

The initial rollout of Microsoft Cluster Server (MSCS) offers functionality for the Windows NT operating system and a standard set of APIs for making applications cluster-aware.

The MSCS API set lets application vendors turn their software into Windows NT resources that MSCS will know about. An application that is cluster-aware allows failover, for example, of an individual database to a clustered machine running the same application. Without the cluster extensions or awareness, the complete application as well as the databases associated with it must be started on the secondary node during failure. This reduces one of the clustered nodes to standby status—hardly a cost-effective proposition. Microsoft IIS 4.0, which we used in our failover test, is already MSCS-aware.

In terms of hardware, the current implementation of MSCS doesn't yet provide traditional clustering capabilities, such as automatic load balancing of cluster- and noncluster-aware applications. You'll need to be aware of the performance issues that will arise when groups running applications such as mail programs on one server node fail over to the other node, the one running your database application.

In addition, plan for environment variables, such as the current physical limit of two nodes and the 25-meter maximum distance between the nodes imposed by the shared SCSI bus.—*Analysis written by Jeffrey G. Witt*

How We Tested

We asked each vendor to ship us its cluster solution with Microsoft Windows NT Server 4.0, Enterprise Edition, on-board.

To test each vendor's MSCS implementation, we installed a Web server, Microsoft IIS 4.0, on each cluster node as our application. Our test-bed clients, Dell Dimension XPS P166 machines, made HTML page requests using Ziff-Davis's benchmark test program WebBench 1.1. One cluster node responded to the page request while the second node stood idle. We powered down the primary server that owned IIS to create a failure scenario. We recorded the time the cluster took to respond, from the moment of failure until the secondary server began to serve pages to the client. The results (in seconds) are the averaged times of ten such trials.

FAILOVER TIME

Bold type denotes first place.

	Seconds
Data General AViON NT Cluster-in-a-Box	27
Dell PowerEdge Cluster	25
Digital Server 3200 and Digital RAID Array 310	28
HP NetServer LH11 and AutoRAID	24

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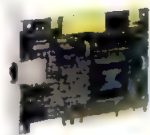
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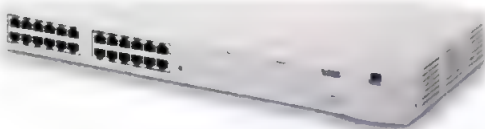
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cal to the CPERC)—Dell should upgrade all its PERCs to offer this capability.

Dell gets around the termination problems of a shared SCSI bus by implementing dynamic termination. The SDS 100 pod, which sits in the middle of the SCSI bus between the two PowerEdge 4200 servers, contains repeater chips that let the SCSI signal pass only when the SDS 100 detects the existence of a server and its internally terminated CPERC. If no server is detected, the signal is segregated to the working side of the SCSI segment. Dell claims that this approach reduces the possibility of introducing noise on the SCSI bus that could corrupt data on the bus when reconnecting a server.

For customers who already own PowerEdge 4200 or 6100 servers and the SDS 100, a \$2,599 cluster upgrade kit includes installation and user documentation, Category 5 cables, the 3Com SuperStack Switch, and the BIOSes necessary to make the servers cluster-aware. A cluster PERC is available for \$1,695.—*Steven Chan*

Dell PowerEdge Cluster. List price: Tested configuration (2 servers, 1 array), \$45,603. Dell Computer Corp., Round Rock, TX; 800-388-8542, 512-338-4400; fax, 512-728-3653; www.dell.com. Choose 901 at www.pcmag.com/infolink.

Digital Server 3200 and Digital RAID Array 310

Digital Equipment Corp.'s Digital Server 3200 and Digital RAID Array 310 constitute an entry-level clustering system for budget-conscious IS managers. This cluster package provides a simple solution with off-the-shelf components familiar to most IS organizations. Using its Server 3200, Digital has assembled a \$28,254 solution for those who are seeking a clustering solution but don't want to purchase and master some of the more complex and expensive components found in other products in this roundup.

Digital is no stranger to clustering. The company began in the early days with VAX minicomputer and mainframe clustering; more recently it has delivered clustering solutions based on Alpha RISC boxes running Digital Unix and Windows NT. Digital is one of the few PC vendors currently offering clustering solutions—in this case, Digital Clusters for Windows NT, which at the hardware level features a clustering configuration that is almost identical to that of Wolfpack. Like Wolfpack, it can connect two machines across a common SCSI bus. The software

features automatic operating-system and application-level sensing and failover. Or more accurately, MSCS is remarkably similar to Digital Clusters for Windows NT, since Digital was one of Microsoft's Wolfpack development partners, though you won't find Digital's role mentioned at www.windows.digital.com.

Customers will find the Digital hardware familiar, since it is based on the earlier Priors line of servers. Each server was configured with two Pentium II processors and 512MB of RAM. The Digital Server 3200 is also available with older Pentium Pro processors, for those companies not yet comfortable with the Pentium II. The system is capable of accommodating up to 512GB of RAM. The 3200 series comes with Digital's on-board Fast Ethernet, which provides 100BaseT, 10Base2, and AUX interfaces via an optional AUX daughtercard. The system also comes with an integrated Adaptec 7880 Ultra-Wide SCSI adapter on-board. Digital's solution uses a separate SCSI adapter, in this case an Adaptec PCI 2944 Ultra-Wide differential SCSI model, to share its disk subsystem.



DIGITAL'S off-the-shelf components make for an economical entry-level cluster solution.



LIKE DELL, Digital uses a single cable to link the servers and subsystems together, providing a potential single point of failure.

The 3200 series is designed to be easy to upgrade and maintain. The processor, mounted directly to the motherboard using a proprietary snap-in board, holds the system processor and memory. So when we upgraded the system from a 200-MHz Pentium Pro to a 266-MHz Pentium II, the process took only a few seconds. Though the Server 3200 uses a typical tower chassis, Digital offers a \$125 Digital Server Rackmount kit.

We also tested the Digital RAID Array 310

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CLUSTERED SERVERS

subsystem, a basic drive array with a single SCSI adapter. This compact tower connects to the two clustered Windows NT sys-

tems with a standard SCSI Y connector, as does the Dell solution, which adds up to a solution that's not very fault-tolerant. Since Digital uses a differential SCSI adapter for the cluster bus, the 310 can be located up to 25 meters from either server. Digital provides configuration utilities that let us create logical groupings of drives that appeared to each clustered system. Similar to products such as Data General's Clariion subsystem, the 310 comes standard with a battery-backed-up write cache to protect data during a power failure.

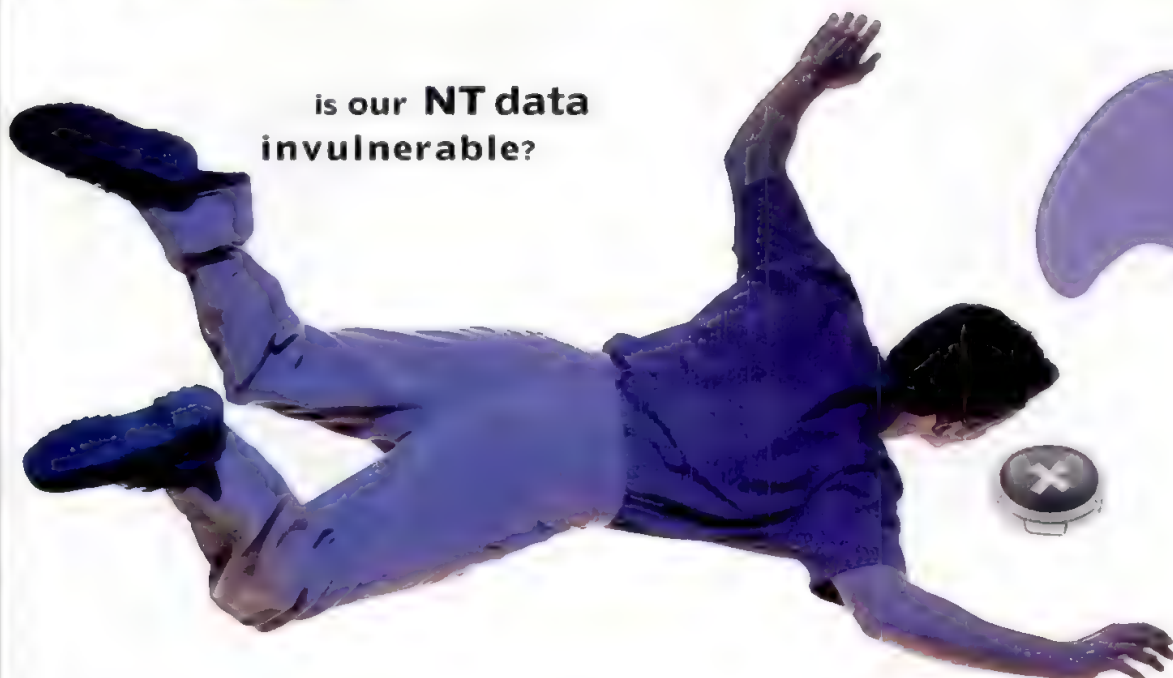
Although Digital is clearly aiming for the lower end of the high-availability market with a simple and inexpensive hardware configuration, the system falls short on the software side for those attempting to install and configure MSCS. Digital says it usually supplies a cluster configuration manual; the company, however, forgot to include one with our test unit. We had no problem installing MSCS using Microsoft's shrink-wrapped Windows NT Enterprise Server CD, which includes Wolfpack. Other vendors such as Data General, however, supplied a far simpler installation solution with step-by-step instructions. Since Digital is all too familiar with the problems of first-time cluster setups, we hope the company will be more diligent in providing better documentation in the future.

Digital's foray into the Microsoft clustering world by no means sets the stage for the demise of Digital Clusters, which was not included in this review. The vendor goes to great lengths to describe future versions of its cluster application that will be compatible with the MSCS APIs. And Digital is still ahead of Microsoft on the application side: Several popular server products, such as Lotus's Domino server and Oracle Server, have been written for Digital Clusters-aware interfaces. Digital's support for the MSCS APIs, however, will only make it simpler for these products to migrate to MSCS.

Digital is currently shipping its ServerWorks line of management software. And although this version does not have any MSCS-specific features, Digital has a new version in the works that is expected sometime in the first half of this year and will make it easier to monitor MSCS clusters.

The Digital Server 3200-based Wolfpack cluster does live up to its claim of being a low-cost cluster package. It deftly leverages popu-

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lar hardware to give IS managers a high degree of familiarity with the system. But better cluster installation documentation and improved management features would be welcome additions.—TP

Digital Server 3200 and Digital RAID Array 310. List price: Tested configuration (2 servers, 1 array), \$28,254. Digital Equipment Corp., Maynard, MA; 800-344-4825, 978-493-5111; fax, 978-506-3023; www.windows.digital.com. Choose 902 at www.pcmag.com/infolink.

HP NetServer LHII with AutoRAID

Though cheaper than traditional high-availability clustering solutions, Hewlett-Packard Co.'s HP NetServer LHII with AutoRAID will cost you; in this roundup, it falls only behind the Data General AViiON NT Cluster-in-a-Box in price. But the \$61,216 price tag includes an HP AutoRAID 12H disk array and offers departmental and enterprise-level network administrators in mixed Windows NT and Unix environments labor-saving tools, such as Dynamic Data Migration, not found in the other products we review here.

The variety of server and disk array combinations offered by HP ensures a solution that can be tailored to fit nearly any work-

group or enterprise environment. For this roundup, HP submitted two department-level HP NetServer LHII dual-Pentium II 300-

MHz servers, each with 512K of L2 cache and 512MB of RAM, and three HP NetServer 10/100TX PCI LAN adapters. In lieu of a RAID controller, which in the Dell solution provided a slight edge in failover rates, HP connected the three internal 4.2GB hard disks to the on-board Adaptec 7880 Ultra-Wide SCSI controller. An Adaptec 2944 Ultra-Wide differential SCSI adapter card connects each NetServer LHII server to its HP AutoRAID 12H.

Though the HP AutoRAID 12H single-enclosure disk array can support as many as 12 half-height 9GB disks, the review unit held only 8 4.2GB disks. This arrangement was sufficient for our testing purposes. The AutoRAID can also hold up to three redundant hot-swappable fans, three redundant hot-swappable power supplies (two are standard), and two redundant hot-swappable RAID controllers, each with 96MB of disk cache. Besides the obvious benefit of having redundant RAID controllers, we like the fact that the two controllers within the Au-

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CLUSTERED SERVERS

toRAID effectively provide each server with its own SCSI bus, unlike the other solutions reviewed here, in which a single SCSI

bus is shared among two servers and the disk array. Therefore the AutoRAID, with its differential SCSI interfaces, can be located up to 25 meters away from each of the servers. The Digital disk array pod, on the other hand, must be located no more than 12.5 meters from at least one of its servers.

We found that the AutoRAID, which works with Unix as well as Windows NT, takes a lot of the work out of administering the disk array by using what HP calls Dynamic Data Migration to balance performance with capacity without any user intervention. Although Dynamic Data Migration may pay off in the end, we found the initial lack of control a little disconcerting. For example, even if the AutoRAID is fully loaded with 12 9GB hard disks, the most capacity you will ever see is about 90GB, since part of the capacity is configured at RAID Level 1+0. Also, Dynamic Data Migration consumes some of the capacity for overhead. The other cluster solutions reviewed offered us the option of RAID Level 0,

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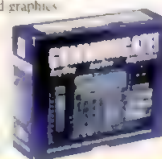
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which gave us access to the maximum capacity of the drives.

Initially, all logical drives that an administrator creates start out at RAID Level 1+0, which offers the best performance of all RAID levels while maintaining redundancy. But RAID Level 1+0 requires the most overhead capacity of all RAID levels. As users require more capacity than RAID 1+0 can provide, the Dynamic Data Migration fea-



THE HP SOLUTION comes with redundant RAID controllers, which in effect give each server its own SCSI bus.



THE DYNAMIC DATA MIGRATION of the AutoRAID array prevents the use of the array's maximum storage capacity.

ture migrates part of the drive array to RAID Level 5, constantly analyzing the disk I/O and attempting to keep the most recently updated files in RAID 1+0. Data that is less frequently changed is stored in RAID Level 5. When a hard disk failed during testing, we found that the AutoRAID automatically rebuilt it: The solution supports an Active Hotspare option with an Auto Rebuild feature. We liked Active Hotspare, because it uses Dynamic Data Migration to add the hotspare disk's capacity to the RAID 1+0 array until the hotspare disk is needed to replace a failed disk. When we turned off the Auto Rebuild option, though, we gained more hands-on control. An Auto Include feature lets administrators add new disks on-line to increase capacity. All data is automatically redistributed throughout the array to include the new disks.

To monitor multiple Unix and Windows NT clusters within a graphical, map-based interface, you will need HP ClusterView for Windows NT, which sells for \$1,400 (list) and works with HP OpenView/Network Node Manager (\$1,995 for a 250-node license). We found the beta version of HP

Net Tools

CLUSTERED SERVERS

ClusterView to be an intuitive means of observing the status of HP Microsoft clusters at a glance. And we liked the way it graphi-

cally depicts clusters using color-coded icons to represent servers and cluster groups—and their status. Dotted lines between cluster groups and servers helped us easily keep track of the servers controlling each cluster group. When we drilled down into a cluster group, we could view a wide variety of information, including a list of its resources and dependencies.

The final version of the HP ClusterView agent for Windows NT is due out by the time you read this. Unfortunately, HP ClusterView currently can manage only HP NetServer Microsoft clusters, HP Unix clusters running HP Lock Manager, and MC ServiceGuard running HP-UX. HP is working with Microsoft on developing a standard management information base.—SC

HP NetServer LHI with AutoRAID. List price: Tested configuration (2 servers, 1 array), \$61,216. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900, 650-857-1501; fax, 800-333-1917; www.hp.com/go/ntclusters. Choose 903 at www.pcmag.com/infolink. **PC**

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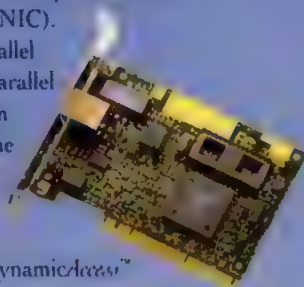
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Net Tools

FROM THE BENCH

WINDOWS NT FIREWALLS

Net Protection

By Robert P. Lipschutz

Interest in firewalls has increased over the last few years as more companies open up to the Internet. For those companies that rely on Microsoft Windows NT to house their network applications and files, a Windows NT server is a natural location for a firewall. Still, for security reasons, we wouldn't suggest loading a firewall on the same machine as your file or application server.

A new member of Cisco Systems' firewall line, Cisco Centri, provides a straightforward and secure Internet connection for small and medium-size networks. It handles basic TCP and UDP services and integrates well with the Windows NT domain security model.

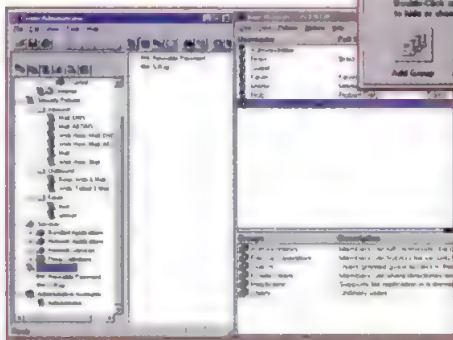
Firewall/Plus, from Network-1 Software & Technology, goes beyond most other firewalls by working with such network protocols as IPX, DECnet, and NetBEUI as well as TCP/IP. It also can regulate other kinds of network traffic including NetWare networks using IPX.

Cisco Systems Inc.

Cisco Centri

Cisco Centri targets small and medium-size companies—those with fewer than 1,000 users—that simply want a secure Internet connection. Keeping in mind its target customers—Windows NT users—the product lets you differentiate access for Windows NT domain users and groups. Starting at \$3,495 (list) for 100 users, Centri does not include any virtual private network capability or support for advanced data-streaming applications, such

as RealMedia or H.323 videoconferencing solutions. We found the object-oriented configuration interface a little difficult to deal with, particularly for a product aimed at small networks. This and a lack of



CISCO CENTRI lets you use the Windows NT domain to determine your users' Internet access.

streaming services might hinder its use in some networks.

During installation, Centri walked us through assigning trusted and untrusted network adapters. It then gave us three choices for a default security policy: basic e-mail and Web; e-mail, telnet, and Web; or a design-your-own policy. We were able to turn all of these into policy rules. Next, we had the option of exposing our internal DNS, mail, and Web servers to the untrusted network, which we do not recommend.

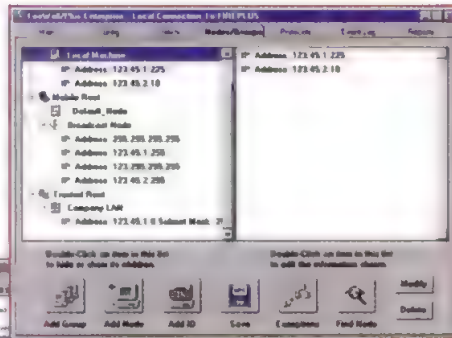
Using a kernel proxy architecture, Centri acts as a proxy, but not at the normal application layer. Like Firewall/Plus, it intercepts packets right off the network adapters. Cisco claims this makes the firewall faster, but for small networks with a T1 Internet connection the performance boost isn't that important.

Similar in this regard to Fire-

wall/Plus, Centri offers the option of running the firewall in either a proxy or a transparent mode. We found it easier to run Centri in the transparent mode, since this mode does not require making client Internet applications aware of the firewall as the proxy mode does. But if you have a complex network with multiple subnets, you'll want to run it in the proxy mode to

Centri doesn't require users to authenticate the first time they attach to a service.

The product also lets you assign individual applications or bundles of applications and services to users based on Windows NT users or groups. Centri covers the basic protocols—FTP, HTTP, SMTP, and telnet. For other protocols and services that may require a single or multiple TCP ports, like IMAP4, NNTP, or POP3, you can add generic TCP proxies. Unfortunately, the generic proxy logs lack the same level of granularity as the logs for the basic protocols. Centri, unlike Firewall/Plus, does not intelligently handle applications such as Microsoft NetMeeting, Real-



FIREWALL/PLUS'S administration GUI lets you configure your network nodes.

save yourself routing headaches.

We liked the way Centri integrates the Windows NT environment into its user configuration. Centri picks up the users and groups configured within the Windows NT domain to assign rules or demand user authentication. And unlike other firewalls,

Media, or other H.323 videoconferencing applications that utilize a TCP control connection to specify subsequent UDP ports for your data streaming.

You can manage the firewall remotely using a Windows NT machine located inside or outside the firewall via an encrypted remote procedure call (RPC). Currently, you can manage only a single Centri firewall at a time.

SUMMARY OF FEATURES

Windows NT Firewalls

	■ YES ■ NO	Cisco Centri	Firewall/Plus
List price (1,000-user license)		\$7,495	\$13,000
Firewall techniques		Kernel proxy	Stateful inspection, HTTP proxy, FTP proxy
Services and Configuration			
Network protocols supported		TCP/IP	TCP/IP, IPX, NetBEUI, DECnet
TCP/IP services		All TCP and basic UDP services	All services
Minimum number of network adapters		2	2
Network address translation (NAT)		■	■
Virtual Private Network			
Firewall-to-firewall connections		■	■
Remote client-to-firewall connections		■	■
Management and Reporting			
Remote administration		■	■
Manage multiple firewalls simultaneously		■	■
Failed-connection alerts		■	■

Cisco bundles a copy of Internet Explorer 3.02, which is necessary to view Centri's important online installation and setup documentation.

Cisco Centri 4.0. List price: 100-user license, \$3,495; 250-user license, \$4,995; 1,000-user license, \$7,495. Cisco Systems Inc., San Jose, CA; 800-553-6387; fax, 408-526-4100; www.cisco.com. Choose 905 at www.pcmag.com/infolink.

Network-1 Software & Technology

Firewall/Plus

Network-1 Software & Technology is ahead of the curve with its Firewall/Plus 4.0 for Windows NT, which supports IPX, DECnet, and NetBEUI in addition to IP. Starting at \$3,750 (list) for 50



concurrent sessions, this firewall also provides network address translation (NAT) and virtual private networks (VPNs) for IP and IPX connections. Aimed at networks of all sizes, the product runs as a Windows NT service on both Intel and Alpha platforms and provides a combination of real-time statistics and event reporting as well as a complete report generator.

Most firewalls use either proxies or stateful inspection, but Firewall/Plus uses both. It uses stateful inspection to monitor and regulate traffic and can also use HTTP and FTP proxies to au-



Frank Dertler

Wow, Leon, these firewalls are more like fire hoses spouting streams of new acronyms and concepts. This area is evolving fast, and potential buyers should evaluate each vendor or VAR's ability to stay in the race. Buyers should also know that standalone VPN solutions are available.

CROSS TALK

It's true that the firewall technologies aren't familiar, Frank; that's why our product comparisons are so important. But I like keeping VPN capabilities integrated within the firewall. If buyers need to make LAN-to-LAN tunnels through the Internet, then they should look at integrated products.



Leon Erlanger

thenticate users before they access services or to generate user activity logs. The product intercepts and inspects packets traveling across network adapters. Packets are allowed or denied based on choices made by the administrator configuration.

After defining trusted and untrusted networks, you can focus on security-policy implementation. Firewall/Plus comes with a configuration wizard and 16 predefined rule sets for typical TCP/IP configurations, ranging from basic Web surfing to strict outbound-traffic-only policies.

Although the product can handle almost any kind of traffic on your intranet, you need to know a lot about your network's protocol, such as the location of the packet information and the number of bytes the information is offset from the beginning of the packet, to get the behavior you desire. The firewall can also distinguish different kinds of NetWare Service Advertisement Protocol (SAP) packets. For example, you can selectively display a sensitive NetWare server to a given group, such as the accounting department. You can also filter out other kinds of traffic, such as AppleTalk zone transfers, VINES server broadcasts, and NetWare RIPs, using the product's more advanced features.

Like Cisco Centri 4.0, Firewall/Plus can run transparently without an IP address. To run in this manner, the firewall must be placed between the Internet con-

nection and the local network. If you want NAT, remote management, or HTTP or FTP proxies, you must assign an IP address.

Firewall/Plus consists of a firewall engine and a user interface for making modifications to the engine. You can remotely manage the firewall by loading the user interface on a remote PC and then connecting to a predefined TCP port over an encrypted connection.

But whether you manage the firewall locally or remotely, you can make rules, or *flags*, by choosing combinations of trusted and untrusted nodes and protocols from the icon-based GUI. By configuring the firewall with individual, groups, or ranges of nodes at setup, you can differentiate users or departments. To invoke the changes, just save the settings.

The report facility contains reports on failed attempts and shows successful conversations between sources and destination addresses. You can generate anything from daily to annual reports for IP, IPX, and DECnet traffic. But in the future, there is one more report we would like to see provided: a printout of the firewall configuration.

Firewall/Plus 4.0 for Windows NT. List price: 50 concurrent connections, \$3,750; unlimited user licenses, \$13,000. Network-1 Software & Technology, New York; 212-293-3068; fax, 212-293-3090; www.network-1.com. Choose 906 at www.pcmag.com/infolink. **PC**

HOW WE TESTED

Beating Down the Walls

Building on our series of firewall security tests (for more information, see "Safety from the Net," *PC Magazine*, November 19, 1997), we put Cisco Centri and Firewall/Plus through a battery of hacker attacks to see if we could make them crack. We installed both firewalls on a Compaq ProLiant 5000 with a Pentium/200 processor and 128MB of RAM. To emulate a typical firewall installation, we allowed internal clients access to FTP, HTTP, and Real Audio, and we locked down the external interface to everything but ICMP traffic.

Our first battery of attacks came from a beta of Internet Security System's Internet Scanner 5.0. We were not surprised that both firewalls easily handled the attacks, since Internet Scanner is a commercially available product.

Next, we downloaded several denial-of-service attacks from the Internet and set

them loose on the firewalls. We noticed that none of the attacks induced the Blue Screen of Death on either firewall. Firewall/Plus was susceptible to two attacks, called Bonk and Teardrop, which tied up about 80 percent of the processor's time on our test machine. A third attack, Smurf, was less successful but still tied up 40 percent of the processor's time as well.

Finally, we used a freeware port scanner called Asmodeus to scan both firewalls. When we enabled ICMP traffic for both of Firewall/Plus's interfaces, Asmodeus caused a Blue Screen of Death as it attempted to scan. Network-1's technical support traced the problem to the RAID controller on our test system and felt the error was not due to the software code. Interestingly, we used the same platform for our Centri testing and did not have a problem.

—Kevin Young

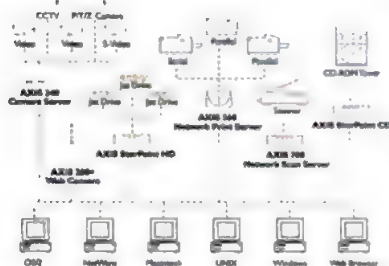
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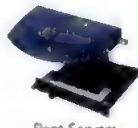
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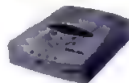
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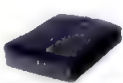
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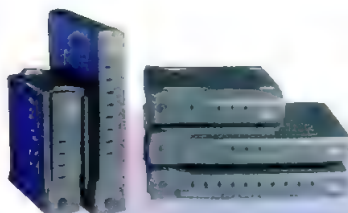
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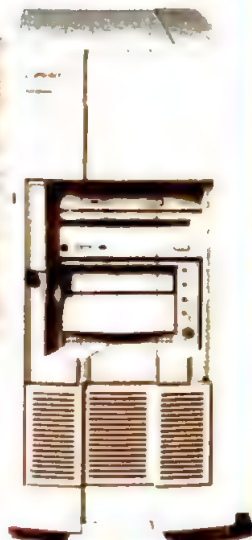
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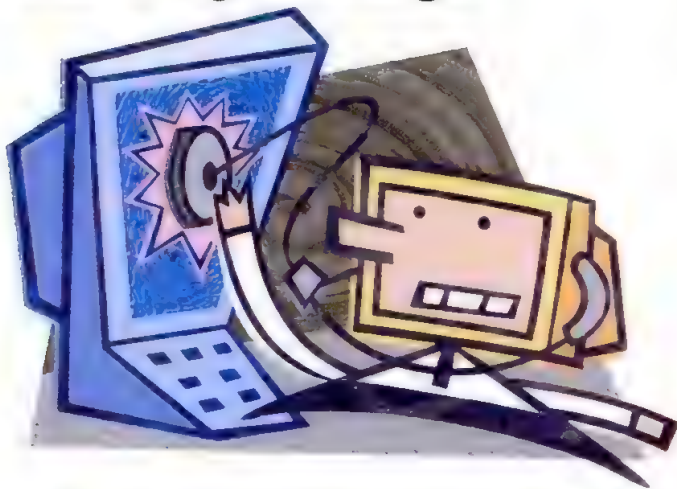
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Net Tools

INTERNET TOOLS

HIGH-AVAILABILITY ALTERNATIVES

Clustering on a Budget



By Tony Pompili

Your Web site is only as reliable as its hardware, and enterprise Web sites need the hardware to support daily multi-million-dollar transactions. Microsoft Cluster Server (MSCS), which starts at \$28,000 for MSCS software and two cluster PCs, promises to benefit Windows NT shops looking for inexpensive, higher-availability systems. MSCS, originally known by its code name Wolfpack, gives Windows NT shops another option for maintaining mission-critical applications. It also makes Windows NT more palatable to traditional big-iron shops not yet sold on the idea that Windows NT belongs in the server room (for more information, see "No Time for Down Time," in this issue.)

But high-availability (HA) systems are hardly new inventions. Existing products ranging from mirroring and hot-standby systems, sold by companies such as Novell (800-453-1267, www.novell.com) and Vinca Corp. (800-

934-9530, www.vinca.com), to 64-host clusters from Digital Equipment Corp. (800-344-4825, www.digital.com) have been providing solutions for systems that must stay up and running. In reality, MSCS is another option on what is already a respectable list of HA products.

Microsoft recognized that it could benefit from building MSCS on the pedigree of tried and true HA products. The result is a product with technology from companies with strong HA reputations, such as Digital and Tandem Computers (800-482-6336, www.tandem.com), as well as other midrange system vendors such as Data General Corp. Although some of these technologies are based on proprietary technology and have six-digit price tags (for example, Tandem Computers' Non-Stop Clusters, which cost \$200,000 or more), MSCS is an attempt to repackage many of the benefits of HA into a less expensive solution.

MSCS is built around such typical PC components as Intel chip

sets, IP networks, SCSI drives, and Windows NT Server. The end result, though not a complete HA system because MSCS shares the limitations of Windows NT, is a product that many IS shops can easily fit into their support structures and budgets.

Although it is limited to two-host clusters and can be connected to disk arrays only by a relatively short SCSI bus, MSCS provides a greater degree of availability than a Windows NT server does alone. Further, all of the MSCS components are familiar PC hardware.

A COMFORTABLE FIT

At its core, MSCS uses the concept of clusters: Two servers are connected in such a way that if one server fails, the second server can take over the first server's tasks with little interruption to any attached client PCs. So if your Microsoft IIS (Internet Information Server) crashes on clustered Server A, Server B will sense the problem and Microsoft IIS will restart, or failover, to Server B.

From the perspective of a user viewing through a Web Browser, a cluster appears to be a single computer. During a failover, the workstation will take longer than usual to open a page. When Server B does failover, you're reconnected and can continue as you would normally. This is the typical experience when users are working on stateless applications, such as a browser with a Web server. For stateful applications, such as database and messaging solutions, MSCS may not always know exactly where to restart you in the application after the failover. During testing, we found that it took about 30 seconds to failover an application such as Microsoft IIS on the server. Some applications could take longer. This may cause some clients to time out with errors such as "server not responding" and is totally dependent on a

given application and its client.

Of course, MSCS can also sense hardware failures, such as network adapter errors and SCSI adapter errors. MSCS generates a virtual cluster IP address. Behind the scenes, MSCS redirects the client to the machine actually running the application. When a failover is triggered, MSCS automatically redirects the user to the healthy clustered node.

To failover an application, MSCS must be able to access the dead server's disks so that the clustered servers share a common SCSI bus. During normal operation, when both servers are up and healthy, each server uses a discrete set of disks. That is, for each clustered server there is a dedicated group of hard disks that are used exclusively by that server. Of course, the server doesn't care about the physical nature of the disk. For example, a set of disks can look like a single disk to the server, but the MSCS will work as long as the other clustered server doesn't use a physical disk. This is what clustering pundits call the *shared nothing* method. Actually, each Windows NT Server can always see the other's disks. But only during failover does one cluster node access both sets of disks.

MSCS is an attempt to repackage many of the benefits of HA in a less expensive model.

Disks are usually external single RAID 5 disk arrays or mirrored arrays running on inexpensive subsystems, such as simple Dell 310 disk arrays. At the pricier end of the scale, MSCS also supports high-performance, fault-tolerant arrays such as Data General Clariion subsystem.

The key to failover is knowing when a cluster node's sibling has died. Cluster computers use a monitoring technique appropriately named the *heartbeat* to check and broadcast their health.

The heartbeat is a ping sent between the cluster nodes, each telling the other node that its sib-

ling is alive. Heartbeats are generated by a cluster-aware component. They can be associated with hardware such as a hard disk or an application. If an application is not cluster-aware, it doesn't generate a heartbeat for the other clustered server to monitor, so it doesn't know when to failover. Thus, writing applications to be cluster-aware is critical.

The heartbeat in a MSCS cluster is sent across a typical network connection, such as an Ethernet network running IP. When a heartbeat fails, the healthy server does failover.

Getting large software vendors on board with MSCS-aware applications is the real linchpin to MSCS's success. Not surprisingly, the first of these applications are Microsoft's own BackOffice products, such as Microsoft Internet Information Server 4.02 and Microsoft SQL Server. But, if Microsoft clusters are to be truly useful, then cluster-aware products must become available from companies such as Lotus, Oracle, PeopleSoft, and SAP.

OTHER FAULT-TOLERANT SOLUTIONS

MSCS is missing some pieces that may force you to turn elsewhere. At the very highest level, MSCS is designed around Windows NT. So if you're a NetWare shop looking for HA file and print, you likely need a NetWare-based solution. One of the best known PC server solutions is Novell's NetWare SFT (Secure Fault-Tolerant) III server. SFT III, which starts at \$50,000 for SFT III software and two cluster PCs, has an advantage over MSCS, because it can connect servers that are physically located anywhere on a LAN or WAN. By contrast, MSCS uses a common SCSI connection to exchange data. Typical SCSI devices can't be more than a meter apart (differential SCSI increases this distance to 3 meters). This limitation is not acceptable if

your survival plan calls for locating servers in separate data centers—for example, New York and Boston. SFT III can work across the network since it uses disk mirroring rather than sharing a common device. With mirroring, each disk write is done twice, once to the local disk and once to the other SFT server.

**Systems based
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Unfortunately, SFT III requires identical servers, and one server must be off-line as a hot-standby, making SFT III a rigid and relatively expensive solution. Novell has been working on its own MSCS-like technology, code-named Orion, which should be in beta in mid-1998.

Other NetWare solutions aren't quite so rigid when it comes to hardware. Vinca's StandbyServer (\$3,999 list) relies on mirroring technology. Unlike SFT III, StandbyServer lets you connect two nonidentical servers. As a result, you can set up an inexpensive hot-standby server to take over, should the primary server fail.

A similar mirroring solution is available from Octopus Technologies (800-919-1009, www.qualix.com) for Windows NT Server. OctopusHA+ (\$1,499 list) is a software-only solution that lets you mirror Windows NT servers one-to-one or one-to-many. Again, you can install Windows NT servers anywhere on a LAN or WAN without being restricted by the length of a SCSI bus.

Although these products improve on ones with SCSI restrictions, other products provide more complete HA solutions for



the hard-core, mission-critical systems such as those designed for OLTP (online transaction processing) financial transactions or Web commerce. Systems such as Tandem Computers's NonStop Clusters demand a greater degree of fault tolerance and redundancy than MSCS can support. Based on RISC N+1 redundant-everything hardware, these systems approach 100% guaranteed uptime. The configuration includes redundant power supplies, network adapters, array controllers, and redundant processors.

NonStop servers can sense failure down to the processor level and automatically switch over to a redundant processor. Tandem Computers provides remote monitoring for your box and issues service calls when it senses a failure.

Prices for the most reliable systems approach or exceed \$300,000. For those who measure their networks in terms of millions of dollars in daily business, the expense is easy to justify. But the cost issue doesn't stop with hardware—the proprietary OS used in systems such as NonStopClusters pumps up application-development costs.

Aware of the need to offer a variety of options, Tandem Computers and its competitor Stratus Computer (800-460-2000, www.stratus.com) are jumping on the MSCS bandwagon. You'll see MSCS options that are less expensive than traditional Tandem Computers or Stratus Computer systems, yet are built on their N+1 hardware architectures and HA experience. Stratus's RADIO

cluster products start at \$200,000.

Digital is a dominant player in the HA market and actually entered the market with a Windows NT clustering solution before Microsoft (800-426-9400, www.microsoft.com) did. Digital's product family, called Clusters, can link up to 64 host computers, creating processors with massive redundancy. Pricing for Clusters starts at \$80,000 for low-end RISC-based and VAX systems. Using technologies such as Fibre Channel to connect to disk subsystems, Digital's Clusters provide applications with a wide range of access to a few terabytes of disk space.

Clearly, not every application needs a 64-host cluster, so Digital has involved itself heavily in the development of MSCS and offers a migration wizard that helps its customers switch from two-node implementations of Digital's NT Cluster to Microsoft Cluster Server. The other area in which Digital already excels is *load balancing*, which allows the cluster to connect users to a given cluster server depending on the number of users already distributed across the servers. Without load balancing, all users could attach to only one of several clustered servers running the same application. This means that one server is working incredibly hard while the others are just loafing. Load balancing is not currently supported in MSCS, though it's expected in the product's next generation.

Ultimately, MSCS's arrival means that for less money and a little more staff training, you can bring higher-availability Windows NT to applications that you can't justify running on high-ticket HA systems. **PC**

Cluster Comparison

Microsoft Cluster Server	NetWare SFT III 4.11	OctopusHA+	StandByServer for NetWare/IntranetWare
 • Inexpensive. • Off-the-shelf components. • Familiar to Windows users	 • NetWare solution. • Not limited by distance.	 • No hardware required. • Not limited to two servers. • Flexible	 • NetWare solution. • Does not require identical servers
 • Limited to two Windows NT servers • Distance limitation between servers	 • Limited to two NetWare servers • Requires a hot-standby server • Requires identical servers.	 • Does not perform failovers	 • Requires a hot-standby server • Distance limitation between servers

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PC Tech



What's New in Windows NT

With so many new features promised for the next version of Windows NT, you'll want to get a head start on mastering them.

By Tim Poulsen

Microsoft is already revving up the hype machine over Windows NT 5.0. The Redmond marketers have announced a Beta 2 release in the second quarter of this year, which likely will mean a final release toward the end of the year or early next year. But regardless of the actual date, now is the time to start investigating Windows NT 5.0.

We recently took Windows NT 5.0 Beta 1 for a test drive. As with most Microsoft betas, we found that this version does not include every innovation promised for the final release. Still, Beta 1 contains many new features—certainly enough for you to get a leg up on the learning curve. Windows NT 5.0 will include the Active Directory Services, the new Microsoft Management Console management tool, many data storage enhancements, and much more. With so many new features, we'll deal mostly with the highlights in this overview, rather than delve too deeply into any one of them.

INSTALLING

Installing Version 5.0 is not significantly different from installing Version 4.0. One great new feature is the ability to upgrade Windows 95 computers to Windows NT. For our tests, we upgraded a Texas Instruments Extensa 550CD laptop running Windows 95 and Office 95 to Windows NT Workstation 5.0 without a problem. The setup utility scanned our system for incompatibilities, reported its findings, and offered us the option of canceling the upgrade if we didn't like what it had found. Other standard setup dialog boxes appeared and quickly disappeared as Setup automatically migrated our Windows 95 settings to Windows NT.

Office 95 and its settings were migrated automatically. We were not prompted for the Office installation disks during the upgrade. For other software, however, you may well need the original setup disks. Some applications install different components on Windows 95 systems than on Windows NT. In those cases, you will need

INSIDE

TUTOR: Monitors are indispensable to using your PC, but the quality of the images they produce isn't always ideal. Find out what causes fuzziness, flicker, and other kinds of distortion. *Page 249.*



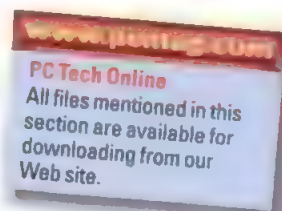
▼ POWER PROGRAMMING:

Windows 98 will bring the ability to use more than one monitor in a virtual desktop scheme. We show you how your programs can take advantage of multiple monitors. *Page 253.*



UTILITIES: This issue's utility, Dupeless, finds all the duplicate files on your system, lists them in a convenient table, and gives you options for deleting them. *Page 259.*

PC SOLUTIONS: Three ways to stop CD-ROMs from auto-playing; considerations when adding a second hard disk to your PC; assigning the tab character to a different key in Microsoft Word; basing the color of cells in Excel on predefined conditions; and much more. *Page 265.*

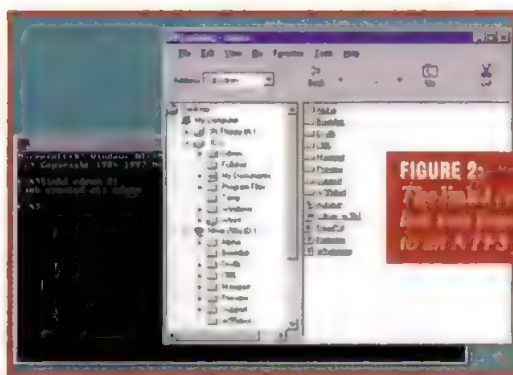


the original disks to add the correct components to your system.

ACTIVE DIRECTORY

With its complex and difficult domain structure, Windows NT has rightly taken a beating for the difficulty associated with setting up and managing large user environments. The Active Directory changes all that by replacing 3.x/4.0-style domains and the complicated multidomain models that large sites require.

The Active Directory is a network-wide hierarchical database of computing resources. That's where you store all information that describes your computing environment, including data about users, groups, computers, printers, and so forth. You still create Windows NT domains in the Active Directory environment, but in addition you'll be able to create a hierarchy of domains to organize your network. Each domain automatically trusts the other domains with *transitive Kerberos trusts*. Transitive (implicit) trusts simplify the job of configuring a multidomain environment. For example, consider a network with domains A, B, and C, in which domain A trusts domain B and domain B trusts domain C. In previous versions of Windows NT, domain A did not inherit any trusts, so domain A did not automatically trust domain C. For such an arrangement, you had to configure the extra trust manually. Now, using the same scenario with Windows NT 5.0 transitive trusts, domain A in-



herits domain B's trust of domain C. In previous versions of Windows NT, domain A did not inherit any trusts, so domain A did not automatically trust domain C. For such an arrangement, you had to configure the extra trust manually. Now, using the same scenario with Windows NT 5.0 transitive trusts, domain A in-

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Active Directory Terminology

Microsoft's new Active Directory Services comes with several new terms you'll need to know. Here are some of the more important ones.

Directory An information store. A telephone directory, for example, stores people's names, addresses, and telephone numbers. A computer-related directory stores information about users, groups of users, computers, and the like. Directories enable users to find resources and enable administrators to manage those resources.

Directory services A directory itself as well as the services it provides, such as security and replication.

Domain In the Active Directory, a partition or portion of the namespace where a common security policy applies. Domains represent replication boundaries; objects and their properties are replicated among domain controllers within the domain but are not replicated to other domains. Domains in Windows NT 5.0 are essentially the same as domains in previous versions, but interactions, trusts, and security among domains are different.

Domain component A portion of a DNS name. For example, in computer.lo.zd.com, each portion of the name—computer, lo, zd, and com—is a domain component.

Domain Name System Provides the underlying name resolution services for

the Active Directory.

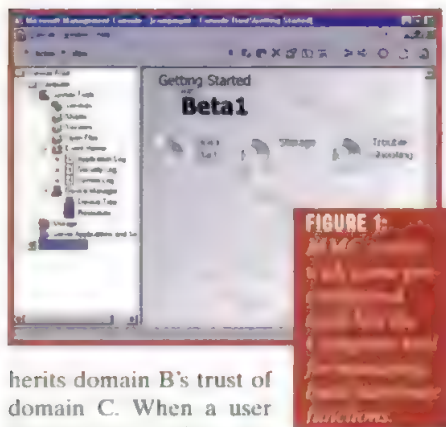
Forest A collection of Active Directory trees (defined below) that do not share a contiguous namespace, but do share a common schema and global catalog. To create a forest, you manually create Kerberos trusts among the trees that will comprise your forest. See Figure A for a graphical representation of forests and trees.

Global catalog Storage of select properties for a subset of objects from all of the domains in the Active Directory. The global catalog enables tree-wide searches for objects.

Kerberos An authentication system developed at the Massachusetts Institute of Technology that uses symmetric key cryptography to ensure authentication and security. Windows NT 5 uses Kerberos security in place of the NTLM security system of previous versions but supports NTLM for backward compatibility.

LDAP The Lightweight Directory Access Protocol, an Internet standard. LDAP is the means by which Active Directory clients and servers communicate.

Multimaster replication The process by which Active Directory domains replicate with each other and resolve conflicting updates. All Active Directory domain controllers maintain a writable copy of the domain database and replicate with



herits domain B's trust of domain C. When a user from domain C tries to access a resource in domain A, the Kerberos security subsystem transparently authenticates the user across domain boundaries via the transitive trust. You'll name your Active Directory domains based on your DNS configuration, such as ntomain.zd.com. Windows NT 5.0-aware applications will use these new names rather than the old NetBIOS-style names (for example, NTDOMAIN).

Windows NT 5.0 can also be easily configured as a workgroup member to support net-

Microsoft has made a number of white papers available on the company's Web site (www.microsoft.com/ntserver/guide/nt5.asp) describing general directory concepts, directory hierarchy principles, and namespace configuration guidelines. Especially helpful are "Active Directory Technical Summary," "Migrating from Microsoft Windows NT Server 4.0 to Windows NT Server 5.0," and "Windows NT 5.0 Namespace Design."

MICROSOFT MANAGEMENT CONSOLE

To manage the Active Directory and the many other aspects of Windows NT 5.0, the new Microsoft Management Console (MMC) replaces older tools such as User Manager and Server Manager. Actually, MMC is simply a shell, providing no management functionality in itself. MMC is a host for add-ons that do supply management functions. These add-ons come in the form of ActiveX controls and are called *snap-ins*. Microsoft calls the combina-

tion of the MMC shell and one or more snap-ins a *tool*.

Some preconfigured MMC tools are available on the Start menu for performing basic administrative functions, such as managing your computer or your directory. You can create your own tools by adding or removing snap-ins. You can save these tools, add them to your Start menu, or distribute them to other administrators.

Figure 1 shows the MMC Computer management tool. MMC uses a Windows Explorer-like interface where the left pane, the Scope Pane, shows container objects that can be managed. The right pane shows properties and details for the object you select on the left. The Computer management tool included with Beta 1 also provides three wizards to assist with basic hardware functions. You get to those by clicking on *Getting Started* in the Scope pane.

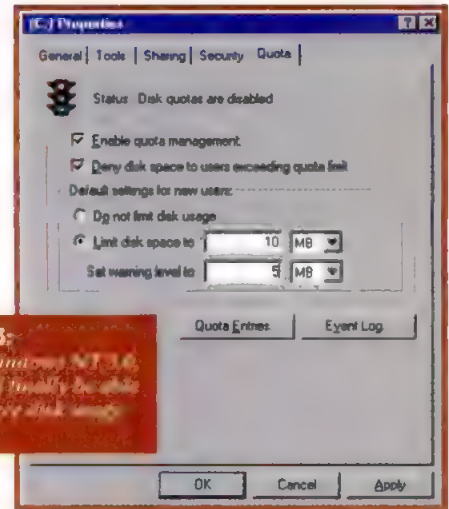


FIGURE 3: With Windows NT 5.0, you will finally be able to manage disk quotas.

Microsoft has announced that its BackOffice suite will be updated to support MMC and snap-ins, and the company expects third-party software vendors to follow suit. In fact, MMC compatibility is a prerequisite to being certified to use the Windows NT 5-compatible logo on third-party software, and many vendors have announced they will comply with the new requirement.

DATA STORAGE ENHANCEMENTS

Version 5.0 will also introduce a number of data storage enhancements, including a new version of NTFS, FAT32 support, disk quotas, the Encrypting File System (EFS), and a new version of the Backup utility. The Distributed File System (DFS) is available now, but Windows NT 5.0 adds fault-tolerant DFS roots and nested junctions, support for DNS-style naming, and integration with the Active Directory.

Version 5.0 of NTFS offers performance enhancements and enables many of the other new features we have mentioned. For example, the new NTFS adds the file-system features necessary to enable disk quotas and file encryption. With dynamic volume support, you can add disk space to volumes without re-booting. Version 5 adds improved link tracking and junction points. Distributed link tracking enables more robust file shortcuts. When you move a file to a new volume or to a different computer, the shortcut is automatically updated to preserve the link. If a link should get broken, the management tools enable you to reestablish it, according to Microsoft's documentation.

Junction points, akin to Unix's symbolic links, let you join a volume to an NTFS folder. The grafted volume appears as if it were part of the folder and does not require a separate drive letter. One potential gotcha, at least in



FIGURE A: With Microsoft's new Active Directory Services, you can see both the trees and the forest.

each other. They don't rely on one master domain controller, as did previous versions of Windows NT.

Namespace A collection of unique domain names. The Internet .com domain, for example, is a namespace that represents all commercial enterprises; zd.com is also a namespace, representing all of the computers operated by Ziff-Davis Inc. A namespace can be *contiguous* or *disjointed*. In a contiguous namespace, a child domain always contains the name of its parent (lo.zd.com as a subdomain of zd.com). In a disjointed namespace, a child domain does not share its parent's name (zdnet.com and zd.com represent a disjointed namespace; both are domains operated by Ziff-Davis).

Object In the Active Directory, a representation of a network resource, including users, computers, printers, and so forth. Objects contain properties, but unlike objects in the programming sense,

Active Directory objects do not have methods.

Organizational unit An object that can hold other objects, in other words, a container of objects. OUs let you create a hierarchy within a domain. OUs can contain other OUs, users, groups, or Distributed File System (DFS) shares.

Schema Defines the objects and their properties that can be created and stored in the Active Directory database. The Active Directory schema is extensible, allowing programmers to add new objects or new properties to existing objects.

Site One or more TCP/IP subnets linked by reliable network connections.

Tree A hierarchy of domains that share a contiguous namespace, a common schema, and a common global catalog. When you add a new domain to an existing domain tree, transitive Kerberos trusts are automatically added with the other domains in the tree (see Figure A).

Beta 1, comes when you break the link. The folder to which you grafted the volume is immediately deleted without warning. Figure 2 shows the `linkd` command being used to join the CD-ROM volume to the Cdrom folder. (In Beta 1, the `linkd` command is not installed automatically. We found it hidden in a Preview folder on the distribution disk.)

Windows NT 5.0 retains support for FAT and older NTFS versions. You can also use FAT32 volumes, which lets you dual-boot with Windows 95 or upgrade those systems to Windows NT. The DOS-like `convert` command can still be used to convert your FAT or FAT32 volumes to NTFS. But the new `chkntfs` command (with the `/E` switch) is the one you should use to upgrade your current NTFS volumes to Version 5. Both com-

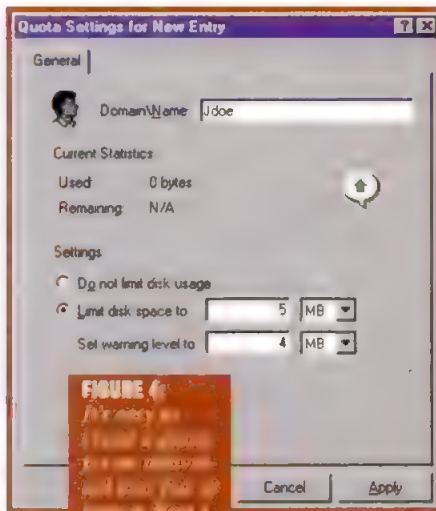


FIGURE 4: The new Windows NT 5.0 Backup utility will finally support backup media other than tape.

mands work without damaging your data, but if you're converting your boot drive, schedule the conversion for the next time you reboot instead of converting immediately. Windows NT 5.0 does not include the capability of converting to the FAT32 format.

To encrypt a file using the Encrypting File System on an NTFS Version 5 volume, right-click on a file or folder and choose Encrypt. Your files are encrypted

using the DES algorithm and your private key. Your files are automatically decrypted when loaded into your applications, provided you are the one accessing the files. Other users cannot decrypt your files or read your data. This transparency is possible because EFS is implemented as a file system driver that sits between the I/O Manager and the NTFS driver within the kernel mode portion of Windows NT. The new model requires no changes to your applications.

To decrypt a file, you right-click and choose Decrypt. The command line cipher command offers more options for encryption and decryption than does the Explorer interface, and there are new encryption-related switches to the copy command for you command-line warriors.

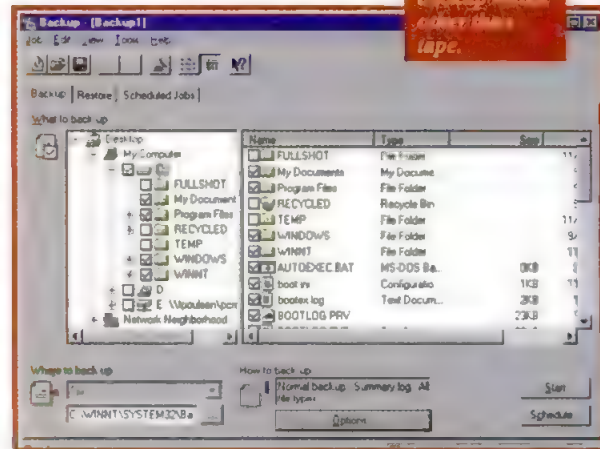
At TechEd 97 (a technical education conference run by Microsoft), Microsoft stated that EFS would work across network shares, but that feature isn't part of Beta 1. Nor can you encrypt files on floppy disks. Of course, floppy disks don't use NTFS, but the ability to store encrypted data on removable

media would seem to be an obvious need. Maybe Microsoft will figure out a way of adding such a feature by the release date.

Until now, if you wanted to limit users' disk-space usage, you have been forced to use third-party solutions. With the release of Version 5.0, you will finally have the option of enforcing disk-usage quotas with an integrated operating-system feature. Quota management can be performed from Explorer or the MMC Disk Management tool. Figure 3 shows the new Quota tab in the properties box for the C: drive.

You can set default limits per volume and set individual user limits. But, at least in Beta 1, you can't set limits on groups. And there is no

FIGURE 5: The new Windows NT 5.0 Backup utility will finally support backup media other than tape.



Browse button, so you must enter user names manually. Figure 4 shows the Quota Settings for New Entry dialog box, which you use to create a quota entry for a particular user.

The quota limits seem to work as advertised, but they don't take effect immediately. Having set a 10MB quota, we were able to copy 20MB of files to the quota-limited drive. When we tried to copy more files, we were then given a message that the drive was full. We discovered another hitch when we deleted the files. Until we emptied the Recycle Bin, the system thought we were still exceeding the limit and would not permit further copies to the drive. Emptying the Recycle Bin solved the problem and subsequent copies, as expected, were limited by the 10MB quota.

Microsoft has enlisted the aid of Seagate Technology to rewrite the Backup utility. The version that will ship with Windows NT 5.0 will finally support backup media other than tape. You will be able to back up local drives and network shares to optical and removable

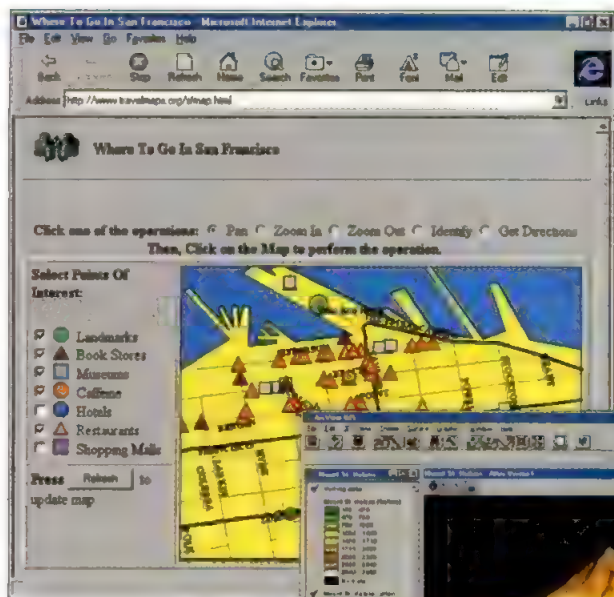
Active Directory Domain Controllers

One of the cardinal rules of Windows NT systems was "once a standalone server, always a standalone server." With Versions 3.x and 4.0, you could not make a standalone server into a domain controller without reinstalling the operating system. (You could always promote a backup domain controller to a primary domain controller, of course.)

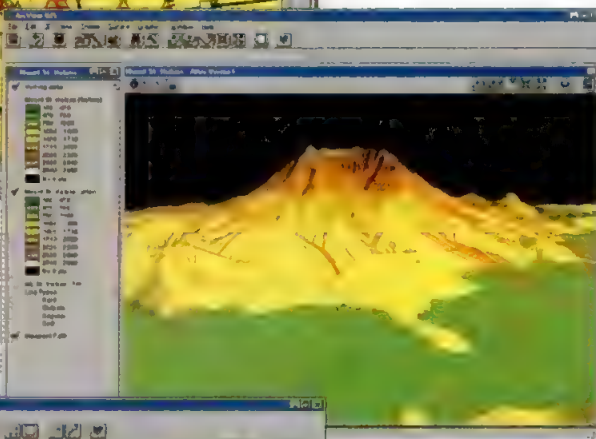
Version 5.0 changes all that. You will now be able to promote a standalone server to domain controller status. As for backup and primary domain controller distinctions, they're gone. In Windows NT 5.0, all domain controllers are equal, as each maintains a fully updatable copy of the domain database.

To set up your first domain controller, Microsoft recommends that you install Windows NT Server 5.0 in a standalone (workgroup) configuration and then install and configure the Domain Name Service (DNS). Domain controllers require DNS to locate each other, so you will need this service running somewhere on your network. Then promote your server to a domain controller and begin creating your Active Directory tree. Subsequent domain controllers can be installed directly as domain controllers. Specify that they are joining the existing Active Directory tree.

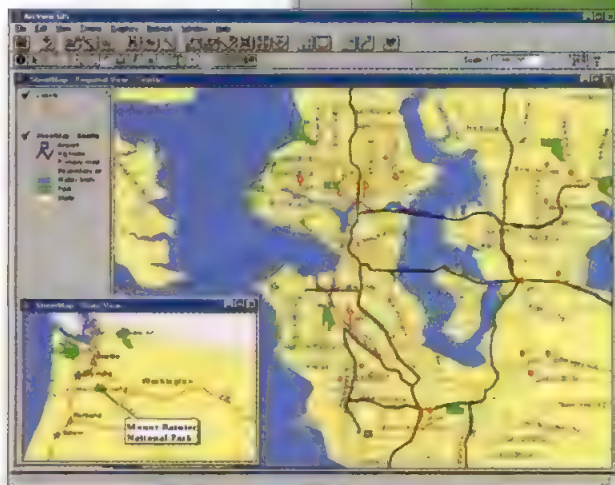
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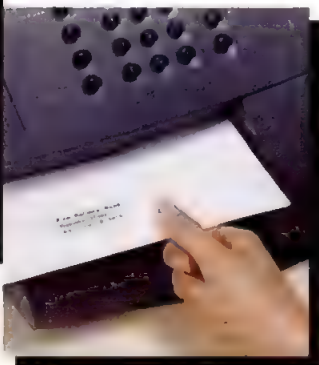
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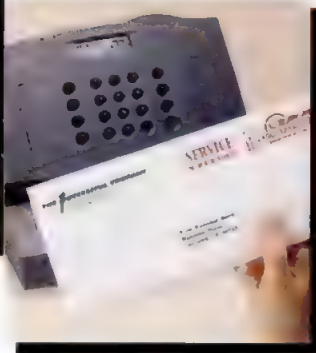
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WINDOWS NT 5.0 HARDWARE REQUIREMENTS

Windows NT Workstation 5.0		
Processor	Minimum	Recommended
Available disk space	486/66	Pentium or Alpha
Memory	274MB (Alpha systems, 351MB)	500MB or more
Other	24MB (Alpha systems, 32MB)	32MB or more
	VGA monitor	SVGA monitor or better
Windows NT Server 5.0		
Processor	Minimum	Recommended
Available disk space	Pentium/133	Pentium Pro, Pentium II, or Alpha
Memory	286MB (Alpha systems, 367MB)	1GB or more
Other	64MB (1-5 network clients)	128MB or more
	VGA monitor	SVGA monitor or better

disks, drive arrays, network shares, and even floppy disks. The new Backup sports a spruced-up interface and even includes a backup and restore wizard (see Figure 5).

NEW HARDWARE SUPPORT

At long last, Windows NT includes Plug and Play hardware support! We plugged an old external (non-Plug and Play) modem into our test desktop system. While the system did not automatically detect the external device, the hardware wizard did correctly identify and install the drivers for the modem. Installing a modem on our test laptop was as simple as plugging in a PC Card. Removing a device was not intuitive, though. We had to choose to change the device's properties in the hardware wizard in order to find the *Uninstall* button.

Also part of Windows NT 5.0 are power management capabilities, via support for the Advanced Configuration and Power Interface (ACPI) specification. Devel-

ment schemes, such as Home/Office Desk, that you can use or customize. The schemes control when the monitor and hard disk will be turned off if your system is inactive.

On our Compaq ProLinea 575 test system, Windows NT 5.0 successfully turned off the hard disk but didn't reliably shut off the monitor after the allotted inactive period. Even so, this is pretty impressive, since the system was built long before ACPI was a glint in a designer's eye. On our test laptop, again not ACPI-compliant, the power manager reliably turned off the monitor and hard disk as configured.

IN SUM

As you can see, Windows NT 5.0 offers a wealth of new capabilities, and that doesn't even count some major new features and enhancements we don't have the space to cover here, like Internet Explorer 4 and the Active Desktop, the demise of NetBIOS, Internet Information Server 4, and the new Microsoft

Transaction Server. Nor did we cover many minor new features, such as the Windows Scripting Host, support for DirectX (you can play Windows 95 games on your NT system), the new GUI-based Task Scheduler, a basic disk defragmenter, full-text searching of local files, and much more. Note that many of these topics have been covered already in *PC Magazine* or will be covered soon. Stay tuned! **PC**

Tim Poulsen is a senior curriculum developer at Ziff-Davis Education (www.zdeducation.com), where he writes MCSE certification-oriented courseware.

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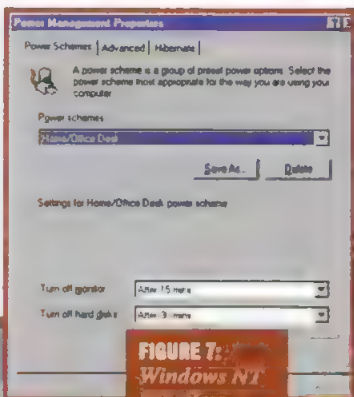


FIGURE 7: Windows NT 5.0 offers advanced power management functions.

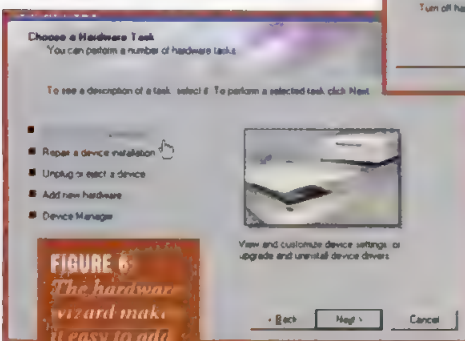


FIGURE 6: The hardware wizard makes it easy to add or upgrade devices on drivers.

oped by Intel, Microsoft, and Toshiba. ACPI enables advanced power management functions such as instant on, low-power sleep mode, and turning off peripheral devices that aren't being used. Through the Power Management Control Panel application, you can configure the power management properties on your system. Beta 1 includes six basic power manage-

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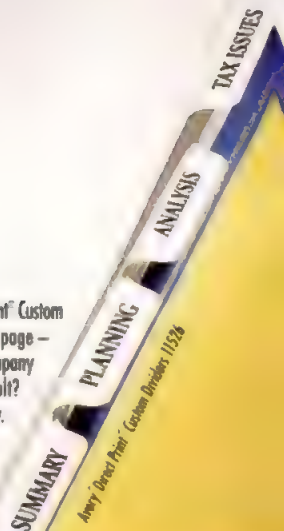


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Image Problems

Understanding fuzzies, blurries, and other eyesores you may be seeing on your monitor.

By Neil Randall

When you're watching "Touched by an Angel" or "Little House on the Prairie," the fuzzies are good. In fact, we call them *warm fuzzies*, because they make you feel all—well, warm and fuzzy. But when you're working on an Excel spreadsheet or scanning through page after page of text on the Web, the fuzzies aren't good at all. These fuzzies don't make you feel good inside, they make your eyes hurt like hell. These fuzzies are monitor fuzzies, blurry letters or shapes that make you think that a visit to your optometrist can't be far off.

A long time ago, I met a person who had just bought a PC but couldn't afford a monitor. He explained that he didn't think the monitor would be necessary if he just spent more time being careful on the keyboard. For at least 99.999 percent of the rest of the population, however, a monitor is essential to our computing needs. What becomes obvious, sometimes too late, is that monitors differ vastly in quality. That good deal you got on the monitor that came with the system might quickly become, quite literally, an eyesore.

One thing you'll discover about monitor quality is that one person's fuzzies are another person's perfect display. To a degree, display clarity has to do with individual differences in eyesight, but it has much more to do with what people use the computer for and what they're willing to accept. The same holds true for audio equipment, of course: One person hears every bit of distortion on the system, while others may not detect any problems at all. For monitors, if you think your display is fuzzy, or imprecise, or aggravating in any other way, then the display *is* a problem. You owe it to both your eyes and your sanity to try to get a better one.

What makes a display fuzzy, distorted, or otherwise bad in the first place? The manufacturer of the monitor will probably tell you that the problem is the video card, and vice versa. And certainly the video card determines display quality to a degree, as we'll see in the next Tutor column. But the lion's share of the problem usually lies with the monitor itself, a complex device in which any number of things can go wrong. Worse still, what's "wrong" might in fact be designed right in. In this column and the next we'll look at some

potential causes of fuzziness and distortion in your PC's display.

This time around, we'll look at the cathode-ray tube (CRT) monitor, the oldest type of display and still the most common. The CRT is essentially a vacuum tube whose face, the glass front, is coated with phosphor compounds. In the CRT, negatively charged electrons are shot by a cathode toward the face of the tube, where they collide with the phosphor coating. The coating converts the enormous energy of the electrons into light, creating the image you see on your screen. The electron guns are one of the four main elements that determine the quality of the image.



FIGURE 1: The three electron beams for each pixel are guided through a single hole in the shadow mask, each striking a different-color dot on the display face.

The others are the shadow mask (replaced in some monitors by an aperture grill), the phosphors that make up the coating on the face of the tube, and the face itself.

ELECTRON GUNS AND PHOSPHORS

In general, color CRTs have three electron guns, while monochrome CRTs have one. Some color CRTs actually have a single gun consisting of three cathodes, but the idea is the same. Since most users today buy color monitors, we'll look only at them. The guns are arranged in a triangular pattern, and each gun emits the electrons in a beam that will hit a three-dot or three-stripe pattern on the face. The electrons would all just hit the center of the display if left on their own, so the CRT uses electromagnets around the edge of the tube that force the beam to

sweep across the display. The magnets guide all three of the beams at the same time (they're fired together), and all three beams hit the same three-dot or three-stripe pattern. More on these a bit later.

The beam traverses the display face one line of pixels at a time (lines are also called scanlines). At a resolution of 1,024 by 768, for instance, each line contains 1,024 pixels, and there are 768 lines that must be drawn each time by the electron guns. When the beam reaches the end of a line, it moves quickly to the beginning of the next line, in an action called a *horizontal retrace*. When it reaches the end of the final line (the bottom-right corner of the display), it moves back to the first line (at the top left), in an action called a *vertical retrace*.

The electron beam is one possible source of fuzziness. The larger the screen, the wider the angle from the absolute center the beam must traverse in order to paint the edges of the display. In the center the beam is circular, but the angle causes it to become increasingly oval as it nears the edges, just as when you shine a flashlight on a wall at an angle. The result is a distortion called *astigmatism*. If you see a monitor—especially a larger one (over 15 inches)—with fuzziness along the edges of the display, this is possibly what is happening. Manufacturers, of course, continue to develop ways to attempt to circumvent this problem.

When the electrons hit the phosphor compound (simply called *phosphors*), the compound glows. This glowing, which happens for varying lengths of time and in different color patterns, is essentially what you're seeing when you look at your monitor. The glowing appears in different colors because a color CRT contains not one but three separate phosphor compounds. The three compounds are arranged together on the screen in three-dot patterns or three-stripe patterns, each dot consisting of a red, green, and blue dot and each stripe consisting of a red, green, and blue line. The three-dot patterns are called *triads* or, more popularly, picture elements. (The term *picture element* is frequently shortened to *pixel* or, in the television industry, *pel*.) To display red, green, or blue, the electrons strike only one dot in the triad. Other colors result from striking two or three of the dots of a pixel, using varying intensities. The space between dots of the same color, which is consistent across the display face, is known as the *dot pitch*.

Among the most annoying and headache-inducing factors in working with monitors is *flicker*. The two factors involved in flicker are

phosphor persistence and refresh rate. *Phosphor persistence* refers to the length of time the phosphor glows after the electron beam hits it. The electron beam paints the image to the screen at a rate of at least 60 times per second, or 60 Hertz—double the rate for TV. It's important that the phosphors persist (or keep glowing) long enough to bridge the gap between these paintings. If they don't, you get flicker. (If the glowing lasts too long, however, you get a ghost image that remains on the screen.)

Flicker is especially a concern with *interlaced* displays, in which the electron guns effectively cheat. In noninterlaced displays, the image is painted line by line from the top of the screen to the bottom, then repainted again from the top. Interlacing involves painting the screen in two stages—the odd-numbered lines and then the even-numbered lines. In effect, you get half the image to begin with, then the other half—filling in the empty lines—during the next firing of the guns. Interlaced monitors can be made less expensively, because they demand less precision and less speed (and thus can contain less expensive components), but many people can perceive the trickery, in the form of flicker.

But flicker is only one possible factor that can undermine the quality of a display. Another is *convergence*, whose name arises from the need for the trio of electron beams to hit each pixel precisely, or to *converge* on it. A monitor that is not manufactured properly, or in fact not adjusted properly, can fail at this requirement; the result will be images in which only partial pixels are illuminated. To the user, this means the fuzzies. You should pay special attention to convergence claims when buying a monitor, because imperfect convergence can be the most significant problem in display clarity. Test the monitor by running a program that displays text in your favorite typeface and font size, and carefully examine the clarity of the text in the center of the display versus that as you near the corners. An even better test is to display a pattern of identical horizontal or vertical stripes and check the center and edges that way. Or load a favorite graphic, one that occupies the entire screen and that you've seen numerous times, and examine its appearance in all locations. If the corners are blurrier, then you probably have a convergence problem. Some monitors let you adjust convergence, but it's better to depend on a qualified technician for this unless you

know what you're doing. It's easy to make a permanently bad adjustment. Many monitors now offer warranties that cover convergence problems for the lifetime of the monitor, but again, make sure nothing has happened to the unit during shipping by testing for the fuzzies.

SHADOW MASKS AND DISTORTION

Of course, a badly aimed trio of electron beams doesn't simply fail to illuminate a specific pixel. It also possibly illuminates an adjacent pixel, thereby producing an even poorer display. Many CRTs use a device called a *shad-*

beams as they make their way to the display face. Instead of dot pitch, aperture grille monitors refer to *screen pitch*, the distance between successive stripes of the same color, and *slot pitch*, the distance between the slots. The only real display issue with the aperture grille is that it is held in place by thin wires running horizontally behind the display, which are often visible to the user. Aperture grilles can also loosen over time, causing some distortion.

The newer NEC and Panasonic displays offer neither a shadow mask nor an aperture grille, but a kind of hybrid called a *slot mask*. The slot mask consists of oval-shaped holes that allow

more of the electron beams to reach the phosphors, thereby resulting in a brighter display. The only real distortion potential stems from the oval shapes, but since electron beams grow increasingly oval as they near the sides and corners of the display, the shapes don't produce new forms of fuzziness but only exacerbate existing distortion possibilities.

The electronic controls that are part of the monitor determine how the beams from the electron guns move through the deflection

system and strike the phosphors, adjusting for the constantly differing angles and paths taken by the beams on their way to the display face. Often, however, the controls can lose their adjustment, resulting in a distorted overall shape of the display. *Barrel distortion* causes the top and side edges to appear rounded outward, instead of straight up and down for the side edges and straight across for the top and bottom edges. The opposite of barrel distortion is *pincushion distortion*, where the top, bottom, and sides appear to round inward. Most monitors offer controls to adjust these distortion types as well as *trapezoid distortion*, where the top and bottom edges are straight across and parallel to one another, but the side edges are straight but not parallel. If you don't adjust these distortions, your image suffers accordingly. (See Figure 2 for an illustration of the different distortion types.)

So far we've seen fuzzies, blurries, flicker, and other types of distortion resulting from such causes as unadjusted controls, attempts to ensure that the electron beams hit their intended dots or stripes precisely, and bad convergence. Next time, we'll examine display resolution and the role that video cards play in the quality of your display's image. **PC**

Neil Randall is the author of *The Soul of the Internet (ITCP)* and *Special Edition Using Microsoft FrontPage 98 (Que)*.



FIGURE 2: *Pincushion distortion (left) makes the display appear to recede inside the monitor, while barrel distortion (center) makes it seem to move out toward the user. Trapezoid distortion alters the rectangularity of the display.*

ow mask (also called a *dot mask*) to combat this problem, while Trinitron displays (developed by Sony) use an aperture grille instead, and some newer displays from NEC and Panasonic use what is essentially a combination of the two.

The shadow mask sits inside the CRT just behind the face, and it's made up of a metal sheet with tiny holes carefully punched in it (see Figure 1). The holes act as guides for the electron beams so that they strike the correct dots precisely. The holes prevent the beams from accidentally illuminating adjacent pixels, thereby offering a more precise image. But shadow masks limit how much of a beam actually strikes the phosphor compound and also restrict the strength of the beam. These limitations can make the display too dim. Some phosphors will be prevented from glowing, and if the beam is too strong, the temperature of the mask increases and the mask expands slightly, producing fuzziness.

Aperture grilles consist of a phosphor pattern of stripes rather than dots on the display face. Each stripe contains phosphors for all three primary colors—red, green, and blue—while the grille consists of an array of slots that run vertically between a series of thin wires, from the top of the grille to the bottom. Like the holes in the shadow mask, the slots both restrict and position the electron

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Programming for Multiple Monitors in Windows 98

How to use the new Win32 API functions that enable your programs to take advantage of multiple monitors.

By Paul Modzelewski

One of the most eagerly anticipated (and long overdue) features of Windows 98 is support for multiple monitors. This feature allows you to add a second video card and monitor to your PC; your Windows virtual desktop will be extended to cover the new monitor. Until now this capability has been possible only through the use of a specialized video card.

Programmers, Web page authors, graphic artists, and power users are the most likely audience for this technology. Most existing programs require no changes to work with multiple monitors, but there are several new Win32 API functions related to multiple-monitor support. If you want your programs to detect and take advantage of multiple monitors, you will need to be familiar with these functions and how they work. In this article, I'll discuss installing multiple monitors on your PC and how to use the new API functions in your programs. The programming section assumes a basic understanding of the Win32 API and C/C++ programming. It is important to note that the information in this article pertains to a beta version of Windows 98 and is subject to change by the time Windows 98 is released.

INSTALLING MULTIPLE MONITORS

Setting up multiple monitors is relatively easy, but there are a few ground rules. Both of your video cards must be on the PCI bus, and your secondary display must be one of the devices supported by Windows. Most popular brands of PCI display adapters are currently supported, and the list will surely expand by the time Windows 98 is released.

One minor issue in the installation process is that the newly added video card will become your primary display. The documentation states that this inconvenience stems from a limitation of the PCI bus. If you want your current video card to be your primary display, you will need to do some installation juggling. Just remember that any newly added display adapter will become your primary desktop.

Once you've installed a second monitor, the Display Properties control panel will contain a new *Monitors* tab (see Figure 1), which

replaces the *Settings* tab. From the *Monitors* tab you can change the positioning of your monitors and the display settings of each individual display, such as resolution and number of colors. Windows uses the monitors' resolution and relative positioning to set up the virtual desktop and its coordinate system (see Figure 2). The top-left corner of the primary display is always position (0,0), with the x-coordinates increasing as you move right and the y-coordinates increasing as you move down. The coordinates of additional monitors are determined by their positions relative to the primary display. Since Windows 98 allows negative coordinates within the desktop window, your programs should not assume that a negative number is invalid when deal-

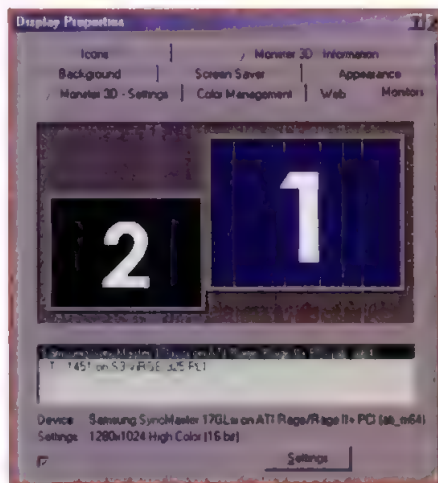


FIGURE 1: Windows 98's Display Properties control panel contains a *Monitor* tab when multiple monitors have been set up.

ing with desktop coordinates.

Because Windows was originally designed to handle only one monitor, some applications will not behave correctly on a multiple-monitor system. While the problems are more often annoying than fatal, most applications will require some slight changes to operate optimally on a system with more than one monitor.

NEW MULTIPLE-MONITOR WIN32 API FUNCTIONS

In order to give applications access to multiple-monitor information, Microsoft has added

several new Win32 API functions and updated several existing functions. In addition to new functions, there is also a new type of handle, the *HMONITOR*, which represents a physical display device. In order to get and set the settings of a particular monitor, you first need to obtain an *HMONITOR*, which will always point to the same monitor.

The first of the new functions we will discuss is *MonitorFromPoint*, which has the following definition:

```
HMONITOR MonitorFromPoint(POINT pt,
DWORD dwFlags);
```

The returned *HMONITOR* is the monitor that contains the *POINT* passed to the function. If no monitor contains the specified point, then the return value of *MonitorFromPoint* is determined by *dwFlags*, for which there are three possible values: *MONITOR_DEFAULTTONULL* returns *NULL* if the point is not contained by any monitor, *MONITOR_DEFAULTTTPRIMARY* returns the primary display device, and *MONITOR_DEFAULTTONEAREST* returns the monitor closest to the point.

```
HMONITOR MonitorFromRect(LPRECT
lprc,
DWORD dwFlags);
HMONITOR MonitorFromWindow(HWND
hWnd,
DWORD dwFlags);
```

MonitorFromRect and *MonitorFromWindow* return the handle of the monitor that contains the largest portion of the specified rectangle or window. If no monitor contains the specified rectangle or window, the return value depends upon the value of the *dwFlags* field, which has the same possible values for these two functions as it does for *MonitorFromPoint*.

Once you have obtained an *HMONITOR*, you can use the function *GetMonitorInfo* to retrieve a *MONITORINFO* structure filled with data relevant to the specified monitor, as follows:

```
BOOL GetMonitorInfo( HMONTOR
hmonitor, LPMONITORINFO lpmi);
typedef struct tagMONITORINFO
{
    DWORD cbSize;
    RECT rcMonitor;
    RECT rcWork;
    DWORD dwFlags;
} MONITORINFO, *LPMONITORINFO;
```

```
typedef struct tagMONITORINFOEXA
{
    MONITORINFO;
```


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```
TCHAR    szDevice[CCHDEVICENAME];
} MONITORINFOEX, *LPMONITORINFOEX;
```

There are actually two versions of this structure, `MONITORINFO` and `MONITORINFOEX`. The `cbSize` member contains the size of the structure, and it is used by Windows to determine whether a structure is a `MONITORINFO` or `MONITORINFOEX`. After a successful call to `GetMonitorInfo`, the `rcMonitor` member contains the rectangle of the monitor within the virtual desktop. The `rcWork` member contains the work area of the monitor within the virtual desktop. (A monitor's work area is the portion not covered by the taskbar.) The `dwFlags` member has only one possible value, `MONITORINFOF_PRIMARY`, which is set if the monitor is the primary display. The `MONITORINFOEX` structure has one additional parameter, `szDevice`, which contains the unique name of the device. The device name can be passed to other functions, such as `ChangeDisplaySettingsEx`, allowing the settings for each monitor to be changed independently.

Before you pass `GetMonitorInfo` a pointer to a `MONITORINFO` or `MONITORINFOEX` structure, you must set the `cbSize` member to the size of the structure so that Windows can determine which structure is being used. The following code sample shows how:

```
MONITORINFOEX mix;
mix.cbSize = sizeof(mix);
GetMonitorInfo(hMonitor,
(LPMONITORINFO)&mix);
```

Some changes were made to `GetSystemMetrics` to allow the use of multiple monitors. Passing `SM_CXSCREEN` and `SM_CYSCREEN` as parameters returns the *x* and *y* extents, respectively, of only the primary monitor. If you wish to get the *x* and *y* extents of the virtual desktop, use the new constants `SM_CXVIRTUALSCREEN` and `SM_CYVIRTUALSCREEN`; `GetSystemMetrics` will return the left and top coordinates of the virtual desktop, respectively. You can no longer assume the top-left corner of the desktop is (0,0), and the extents will do you no good if you don't know the origins. Passing the new constant `SM_SAMEDISPLAYFORMAT` to `GetSystemMetrics` will return `TRUE` if all of the monitors on the system have exactly the same color settings, `FALSE` otherwise. Use the constant `SM_CMONITORS` when you want to know how many monitors make up the virtual desktop. Note that this value includes only installed monitors that have been added to the desktop by the user.

The `SystemParametersInfo` function has

also been changed slightly. The changes affect only the `uiAction` values `SPI_GETWORKAREA` and `SPI_SETWORKAREA`. Using the former always returns the work area of the primary monitor. If you want to get the work area of another monitor, you need to use `GetMonitorInfo`. Using `SPI_SETWORKAREA` sets the work area of the monitor that contains the `RECT` structure passed into the `pvParam` value.

`EnumDisplayMonitors` is a new function that allows an application to optimize its drawing code when a window is being partially displayed on multiple monitors that have different color-bit depths.

```
BOOL WINAPI EnumDisplayMonitors(
HDC hdc,
LPCRECT lprcClip,
MONITORENUMPROC lpfnEnum,
LPARAM dwData);
```

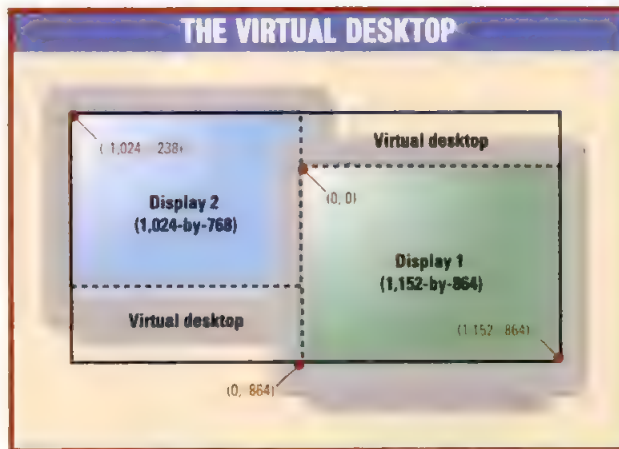


FIGURE 2: Windows uses the resolution of each monitor and the relative positioning of the monitors to set up the virtual desktop and its coordinate system.

The `MONITORENUMPROC` callback is called for each monitor that intersects the visible region of `hdc` and the `lprcClip` parameter. If the `lprcClip` parameter is `NULL`, then no additional clipping is performed. The `dwData` parameter is for user-defined data and is passed through to the `dwData` parameter in the callback function. `MONITORENUMPROC` is a user-defined callback function that must have the following signature:

```
BOOL CALLBACK MonitorEnumProc(
HMONITOR hmonitor,
HDC hdcMonitor,
LPCRECT lprcMonitor,
DWORD dwData);
```

If the `hdc` passed to `EnumDisplayMonitors` was `NULL`, then `hdcMonitor` is `NULL`. Otherwise, `hdcMonitor` contains a valid device context whose color attributes match the dis-

play monitor defined by `hmonitor`. If `hdcMonitor` is `NULL`, then `lprcMonitor` is in virtual-desktop coordinates. It is important to note that no application needs to use `EnumDisplayMonitors` to handle monitors of differing bit depths, since Windows automatically dithers high-color images on lower-color devices. You should use this function only if you want to do custom dithering to ensure the best possible display. In order to help you understand exactly how `EnumDisplayMonitors` is used, I will present a couple of code snippets illustrating common usage scenarios.

One use for `EnumDisplayMonitors` is to make sure that images are drawn optimally on lower-color devices. The best way to do this is to change how your window's `WndProc` handles the `WM_PAINT` message.

```
case WM_PAINT:
HDC hdc;
hdc = BeginPaint(hWnd,
&paintStruct);
EnumDisplayMonitors(hdc,
NULL, monitorEnumPaintProc,
0);
EndPaint(&paintStruct);
```

Inside your callback, you query the passed device context to determine its capabilities and display area and do your drawing accordingly.

You can also use `EnumDisplayMonitors` to query every monitor on the desktop. If the device context and `RECT` passed into `EnumDisplayMonitors` are both `NULL`, no clipping is performed and your callback function is called once for each monitor in the virtual desktop. The code in Figure 3 caches the work area of every monitor for later use. (Note that if your application actually did this, you would need to update the cached information when the `WM_DISPLAYCHANGE` message was received, since the values might change.)

Another way to query display devices is the `EnumDisplayDevices` function, which can query all devices available on the system, whether or not they're part of the virtual desktop.

```
BOOL WINAPI EnumDisplayDevices(
PVOID Unused,
DWORD iDevNum,
PDISPLAY_DEVICE lpDisplayDevice,
DWORD dwFlags);
```

`Unused` is reserved for future use and must be set to `NULL`. There are no valid values for `dwFlags`, so set it to 0. `iDevNum` is the index of

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The image shows a computer screen with a form titled "INFORMATION ABOUT THE EMPLOYEE". The form is part of a software application, as evidenced by the menu bar at the top (File, Edit, View, Window, Help) and the toolbar with icons for various functions. The form fields and their contents are as follows:

- EMPLOYEE'S NAME:** [Handwritten: F]
- DATE OF BIRTH:** [Handwritten: 6/1/62]
- SEX:** [Handwritten: M]
- SSN:** [Handwritten: 123-45-6789]
- DATE OF HIRE:** [Handwritten: 1/1/80]
- HOME ADDRESS:** [Handwritten: 123 Main St, Anytown, PA 12345]
- CITY:** [Handwritten: Anytown]
- STATE:** [Handwritten: PA]
- HOME PHONE:** [Handwritten: 123-4567]
- MARITAL STATUS:** [Handwritten: Married]
- NUMBER DEPENDENTS:** [Handwritten: 2]
- PRIMARY CARE PHYSICIAN:** [Handwritten: Dr. Smith]
- DO YOU (Donorship):** [Handwritten: No]

The form is displayed on a screen with a Windows-style interface, including a menu bar and a toolbar. The form is titled "INFORMATION ABOUT THE EMPLOYEE" and contains various fields for personal and employment information. The fields are labeled with bold text, and the user has entered handwritten data into many of them. The form is part of a larger application, as indicated by the menu bar at the top of the screen.

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the device you wish to query and is zero-based. If there is not a device available in the `iDevNum` position, `EnumDisplayDevices` returns `FALSE`. If there is a device in the position indicated by `iDevNum`, `EnumDisplayDevices` returns `TRUE` and fills in `lpDisplayDevice`. So to examine all devices on the system, you'd call `EnumDisplayDevices` for each possible index, starting with 0, until it returned `FALSE`. The `lpDisplayDevice` parameter is a pointer to a `DISPLAY_DEVICE` structure, which is defined as follows:

```
typedef struct _DISPLAY_DEVICE {
    DWORD cb;
    BYTE  DeviceName[32];
    BYTE  DeviceString[128];
    DWORD StateFlags;
} DISPLAY_DEVICE, *PDISPLAY_DEVICE,
*LPDISPLAY_DEVICE;
```

The `cb` member contains the size of the structure in bytes. `DeviceName` is the same unique name returned by `GetMonitorInfo` in the `szDevice` member of the `MONITORINFOEX` structure. `DeviceString` is a user-friendly description of the enumerated device. Unfortunately, I was not able to find documentation on the possible values of `StateFlag`, but they seem self-explanatory. Here are their definitions as listed in the Win32 SDK:

```
#define DISPLAY_DEVICE_
_ATTACHED_TO_DESKTOP
0x00000001
#define DISPLAY_DEVICE_
_MULTI_DRIVER
0x00000002
#define DISPLAY_DEVICE_
_PRIMARY_DEVICE
0x00000004
#define DISPLAY_DEVICE_
_MIRRORING_DRIVER
0x00000008
#define DISPLAY_DEVICE_
_VGA_COMPATIBLE
0x00000010
```

Since `EnumDisplayDevices` allows you to query devices that aren't part of the desktop, your application can use monitors in an exclusive manner, without having to share the screen with the desktop. To do this, find a device that doesn't have the `DISPLAY_DEVICE_ATTACHED_TO_DESKTOP` bit set and call the Win32 API function `CreateDC`, passing

the name returned in the `DeviceName` member of `lpDisplayDevice`. If you create a device context in this manner, you should delete it when you're done with it by calling `DeleteDC`.

OTHER ISSUES

If you use these new API functions to make your applications multiple monitor-friendly, what will happen on systems running a version of Windows that does not have the multiple-monitor functions? (Neither Windows 95 nor Windows NT 4.0 includes the multiple-monitor APIs.) They will crash, unless you do something about it. The solution is a new header file, `Multimon.h`, which uses `GetProcAddress` to determine whether the relevant functions are actually in the system DLLs. If they are not, it supplies default implementations of these functions. This header file actually contains source code, and if the `COMPILE_MULTIMON_STUBS` flag is set, the code will be compiled. This means that you should define `COMPILE_MULTIMON_STUBS` in one—and only one—source file that includes `Multimon.h`. You can include `Multimon.h` in as many source files as you want, but make sure that `COMPILE_MULTIMON_STUBS` is defined in

only one. The end result of this process is a single executable file that will run on all versions of Win32.

There are also a few new rules you should follow if you want your programs to behave correctly on a multiple-monitor system. Remember that negative desktop coordinates are now valid, so don't assume otherwise. For example, don't hide your application by moving its window to a negative position. You should also take care when centering dialogs on a monitor. If you don't check which monitor your application is on, you may be centering your dialog on the wrong monitor.

Another potential pitfall is the incorrect casting of window message parameters that are window coordinates. Since negative coordinates used to be invalid, it didn't matter if you accidentally cast an integer position value to a `DWORD`.

If you follow sound coding practices in general, you should find that your application will require very little work to become multiple monitor-friendly. When Windows 98 is finally released, multiple-monitor systems will probably become fairly common. If you want

to make your programs as high in quality as possible, or if you target a market where multiple monitors will be prevalent, add some multiple-monitor situations to your test plans.

Microsoft has done quite a good job of incorporating multiple-monitor support into an OS that wasn't designed for it. But applications written before multiple-monitor support was available may behave unreliably, especially when displayed on a monitor other than the primary monitor. My own experience has shown that while such problems can be frustrating, they can be worked out. Once you have adapted to the multi-monitor quirks of your applications, it's hard to go back to the confines of a single monitor. If you have an old 14-inch monitor sitting around, you may find it worthwhile to buy a cheap PCI video card and set up a second display. **PC**

Paul Modzelewski is a software engineer and cofounder of Iconoclast Software. He can be reached via e-mail at paul@moon.jic.com.



FIGURE 3: This code snippet caches the work area of every monitor for later use.



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Don't Waste Disk Space

Dupeless ferrets out duplicate files on your hard disk and helps you decide which ones to blow away.

By Neil J. Rubenking

How many copies of Vbrun300.dll does your computer contain? Chances are good that your hard disk is littered with duplicate files. Some have the same name but may or not be identical. Some identically named files are different versions of a dynamic link library or ActiveX control, and these duplicates can sometimes cause system problems. Other files are simply space wasters—identical in size and contents, but stored under different names. Dupeless ferrets out duplicate files of every kind and helps you remove them from your hard disk.

You can obtain Dupeless by downloading it from PC Magazine Online or by mail. Refer to the sidebar "Getting the Files" for details. The Delphi 3 source code for Dupeless is also provided for programmers interested in seeing how it works.

INSTALLATION

Dupeless is supplied as a self-contained install program. Run this program to install Dupeless and all its files in the directory of your choice. The program will add Dupeless, its help file, and an uninstall utility to your Start menu. Dupeless runs under Windows 95, Windows NT 4, and Windows NT 3.51. Note that the Recycle Bin was added to Windows NT starting with Version 4; if you are running an earlier version of Windows NT, the option to move unwanted duplicates to the Recycle Bin will be disabled.

In order to find duplicate files on your system, Dupeless needs to maintain information about all of the files at the same time. That could be a lot of information, so Dupeless uses temporary storage on-disk rather than attempting to keep it all in memory. These temporary files are created in the same folder that holds Dupeless and can total several megabytes in size. Thus you should install Dupeless on a drive with sufficient free space.

DUPELESS OPTIONS

You don't need to run Dupeless every day, but every month or so you'll want to clean up your hard disk and recover any space wasted on duplicates. You'll want to start every session by setting or reviewing Dupeless's options. The Options dialog lets you specify what criteria Dupeless should use in deciding whether files are duplicates. It also lets you set the deletion method, choose which drives to scan, optionally set a starting directory for each drive, and set the colors that will be used to distinguish sets of duplicates in the output display. The comparison and drives options take effect on the next scan; the deletion and colors options take effect immediately.

Dupeless

Dupeless ferrets out duplicate files and helps you remove them from your hard disk, offering comparison options that let you define what files constitute duplicates.



Dupeless lets you define what constitutes a set of "duplicates" in these ways:

- different versions of the same file (same name);
- copies of the same file (same name and size);
- identical copies of the same file (same name, size, and contents);
- unexpected identical files (different names but same size and contents).

The Comparison options box is where you make your selections.

Either filename or file size must be used in

all comparisons. If neither of these comparison options is checked, the OK button and the time/date check box will be disabled.

You can do a date/time comparison only if you are also doing a filename or file-size comparison. With the date/time box checked, two files won't be considered identical unless they have the same date/time stamp. In most cases, you should leave this check box blank. It is offered as a refinement in case the other choices produce too many apparent duplicates.

If you check the Compare file Names option, you also have the option to compare the files' version numbers. When you check the ... and also display version info option, Dupeless will display the version numbers of duplicate 32-bit .DLL and .EXE files, if available.

If you check the Compare file Sizes option, you also have the option of comparing the files' contents. When you check the ... and also compare contents option, Dupeless will report only files with identical contents as duplicates. Files need not have the same name to be identified as identical in content.

Once you've chosen your comparison options, you need to tell Dupeless where to look. The Options dialog lists all fixed disks and removable disks on your system. A check box to the left of each lets you select which disks to scan. Dupeless does not list CD-ROMs, network drives, or RAM disks. By default, fixed disks are checked and removable disks are not.

To check or clear a box, double-click anywhere in the corresponding row, or navigate to the desired row with the Arrow keys and press the Spacebar. The context menu that appears when you right-click on a row also contains options to check or clear that row's box. Highlight any drive row and press the Browse button to set a starting directory for searching that drive, or right-click the row and choose Browse from the context menu. The OK button will be disabled if you clear all the drive check boxes.

The deletion-options group lets you tell Dupeless what you mean by "delete checked files." In most cases, you should not choose permanent deletion. One of your applications may depend on finding a file in a particular location. Under Windows 95 or Windows NT 4, you can send the duplicates to the Recycle Bin. If you find you're still able to run all of

FOR PROGRAMMERS ONLY Dupeless is a 32-bit Windows application written in Borland's visual programming tool, Delphi. It compiles under Delphi 2.0 or higher. The source code for Dupeless is available on PC Magazine's Web site (www.pcmag.com) and demonstrates several programming techniques, including:

- sorting a huge list by merging smaller sorted lists;
- locating identical files quickly by putting off byte-for-byte comparison as long as possible;
- sending files to the Recycle Bin in Windows 95 or Windows NT 4.

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your applications, then after a week or so you can feel free to empty the Recycle Bin.

If you'd rather archive the duplicates or if you're running Windows NT 3.51, you should use the third option—*Move to Dupe\$\$\$\$ folder*. Instead of deleting a file, Dupeless will move it and its path information into a folder named Dupe\$\$\$\$, which the utility will create in the root directory of the same drive. For example, C:\windows\system\useless.dll would be moved to C:\Dupe\$\$\$\$\windows\system\useless.dll. You can use your favorite compression program to archive the duplicates, if you wish. As with the Recycle Bin option, if you find that after a week or so none of your applications show any signs of needing the removed duplicates, you can delete the Dupe\$\$\$\$ folders.

Dupeless uses alternating stripes of color to distinguish different groups of duplicate files. By default, the stripes are yellow and cyan. However, the Options dialog lets you choose your own two favorite colors instead. Be sure to choose colors that are distinct from each other and contrast well with the text color.

EXCLUSIONS

Using the Exclusions dialog, you can instruct Dupeless to ignore all files in and below a particular folder, all files that have a specific

name, or all files with a particular extension. The first time you run Dupeless, it will insert its own folder and your system-defined TEMP folder into the list of folders to ignore. If you're running Windows 95, it will also add the SYS-BCKUP folder, which is found in the Windows folder. You will probably want to add other folders to this list, such as the history and temporary folders used by your Internet browser.

The list of filenames to ignore initially contains MSCREATE.DIR and ANTI-VIR.DAT. Many systems will have dozens or even hundreds of files matching one of these names. Depending on your system's particular collection of files, you may want to add other names to this list. You must add specific filenames; wildcards are not allowed. The list of extensions starts off containing .\$\$\$ and .TMP, both commonly used for temporary files. (It's quite common to find temporary files whose contents are identical to those of the corresponding permanent files.) Again, wildcards are not allowed.

If you wish to try scanning without exclusions, you don't have to empty the three lists. Instead, clear the *Enable Exclusions* check box at the top of the dialog box. However, regardless of whether exclusions are enabled, Dupeless will always exclude any directory named Dupe\$\$\$\$ or Recycled found in the

root directory of a drive. As mentioned above, the Dupe\$\$\$\$ folders are created by Dupeless itself to hold unwanted duplicate files.

SCANNING, REVIEWING, REMOVING

Once you've set the options and exclusions, you can start Dupeless scanning for duplicates. If you're not comparing file contents, the process is usually over in a few minutes. The file-contents comparison can take quite some time, so you may want to start it just before you go to lunch. When Dupeless has finished scanning for duplicates, the utility will list all the sets of duplicate files in a grid (see Figure 1). While scanning is in process, the *Abort Scan* menu item and corresponding taskbar button are enabled. Use the abort feature with care, as it will stop the scan, discard any partial results, and reset Dupeless to the prescan condition.

Regardless of which comparison options have been chosen, Dupeless displays the name, path, size, and date/time stamp for each file. If you've checked the *Version* option, a fifth column will display version information, if available, for any 32-bit .EXE or .DLL files in the grid. All files in a group of duplicates will be displayed with the same background color. By default, the colors alternate between pale blue and yellow.

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Check the box at the far left of a row to indicate that you want the corresponding file removed. To check or clear a box, double-click anywhere in the corresponding row, or navigate to the desired row with the Arrow keys and press the Spacebar. The context menu that appears when you right-click on a row contains options to check or clear that row's box, as well as several options that act on the entire group. The *Check Group (Except One)* option unchecks the selected row but checks all other files in its group. The *Uncheck Group* option clears all check boxes for the selected row's group. Finally, as some searches result in very large groups, the *Count Group* option reports the number of files in the selected row's group.

When you've carefully reviewed the results and checked off the files to be removed, choose *Delete checked files* from the Action menu or press the corresponding speed button. Depending on which deletion option you chose, Dupeless will permanently delete the checked files, move them to the Recycle Bin, or move them to a \Dupe\$\$\$\$ folder in the root directory of the same drive. If Dupeless successfully processes a file, it will delete the corresponding line from its list; otherwise, it will leave the line in place, check mark and all. Some files may no longer be duplicates after the deletion process, and these are removed from the list as well. Finally, Dupeless adjusts the background colors for any remaining items so that the groups of duplicate files still alternate between the two background colors.

You may wish to print the results of a search or save them for later reference. Select *Save list to file* from the Action menu, or press the corresponding speed button. This will store the grid's contents in a rich-text format (RTF) document named Dupeless.rtf, in the same folder as Dupeless. Almost any modern word processor can import this type of file. The results are displayed in a tabular form, similar to the grid display within Dupeless itself. Groups of duplicates are separated by solid horizontal lines, and items checked for deletion appear in strikeover text. If you print this document from within your word processor, the header on each printed page will indicate the date on which the search was performed as well as the criteria that were used in comparing files.

You'll probably be amazed at the number of duplicate files Dupeless finds the first time you use it. And even though the prices of immense hard disks continue to drop, there's never a good reason to waste disk space.

INSIDE DUPELESS

The biggest challenge in writing Dupeless was allowing it the flexibility to find duplicate files based on a variety of definitions, and letting it do so in something less than geologic time. Speedily matching up files with identical contents was a separate challenge, solved in part by having Dupeless defer the actual file-contents comparison until all other conditions match. I will also describe how to call on Windows to handle file services such as moving files to the Recycle Bin.

One way to find the duplicates in a list of files would be to compare the first file with the second, third, fourth, and so on, then compare the second file with the third, fourth, fifth, and so on. However, the number of comparisons required in such a scheme depends on the square of the number of files. Specifically, if n is the number of files, then $(n^2-n)/2$ comparisons are needed. On a system with 40,000 files, that would be 799,980,000 comparisons!

the length of a long filename, I use a question-mark delimiter at the end of the filename portion and an asterisk at the end of the path. I use these two characters as delimiters because they can't appear in an actual filename. Thus a filename like C:\Windows\System\Scrolling Marquee.scr becomes Scrolling Marquee.scr?C:\Windows\System*.

Regardless of the comparison options, the file-data string must always include the size, date, and name, because Dupeless displays this information in its list of duplicates. However, for it to sort the list properly, the items corresponding to selected comparison options must come first. Thus the order of the size, date, and name items within the string of file data depends on what comparison options the user has selected.

Since items used for comparison precede those not used for comparison, the string is, in effect, two sublists that each can contain from zero to three items. In each sublist, size always

precedes date, and date always precedes name. Some examples will help clarify. If the user selects a size and date comparison, the order will be size, date, and name. If the user selects a name comparison, the order will be name, size, and date. When seeking duplicates in the final sorted file, Dupeless only examines the portion of the string corresponding to selected options.

To handle sorting such a large list, Dupeless uses a two-stage approach. Each file's formatted representation is initially added to a sorted TStringList object. As the number of lines in the TStringList gets larger, adding a new item in sorted order takes more and more time. Dupeless avoids this slowdown by dumping the list's contents to a temporary file when the number of items hits the arbitrary limit of 4,096, and then clearing the list.

When all of the file information has been recorded, Dupeless performs a merge sort on the temporary files. A single merge operation starts by reading a line from each of two input files. It compares the two lines, writes the smaller of the two to its output file, and replaces that line with the next line from the same input file. The result is a new file that contains all the lines from the two input files, in sorted order. One pass through the merge-sort process combines files 000 and 001 into a new file 000, files 002 and 003 into a new file 001, and so on. Each pass halves the number of temporary files, and the last pass produces a single sorted list of all files to be compared.

Now Dupeless has a text file on-disk con-

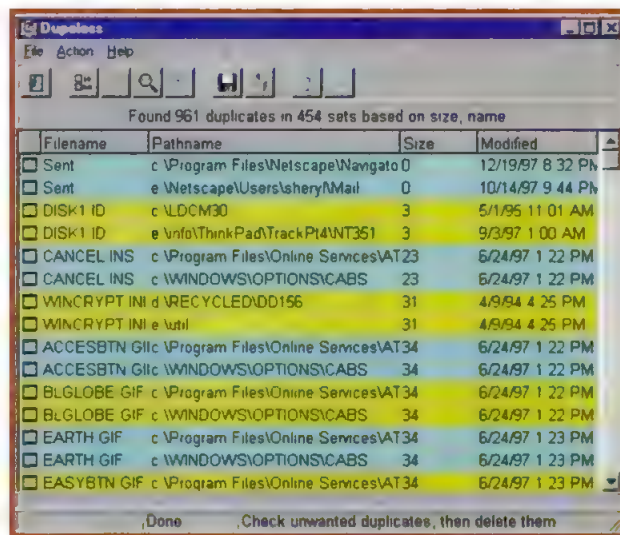


FIGURE 1: Dupeless can find files that are identical even if they have different names.

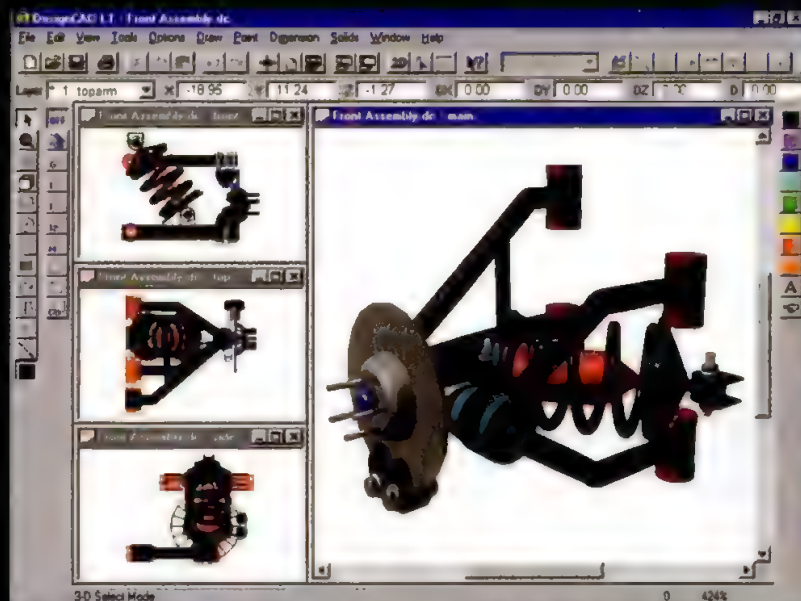
Fortunately, Dupeless doesn't need to compare every pair of files. All of its criteria except contents can be handled by preparing a list of all files and sorting the list so that duplicates are adjacent. To do this, Dupeless starts by stepping through the directory structure of each drive specified in the Options dialog. For each file, it records the name, path, size, and date/time stamp in a specially formatted text string. The file size and date/time stamp are converted to eight-digit hexadecimal strings. The full pathname is rearranged to put the filename portion first.

In the old days of 8 + 3 filenames, I would have simply allocated eight characters for every filename and three characters for every extension. Since there's no specific limit on

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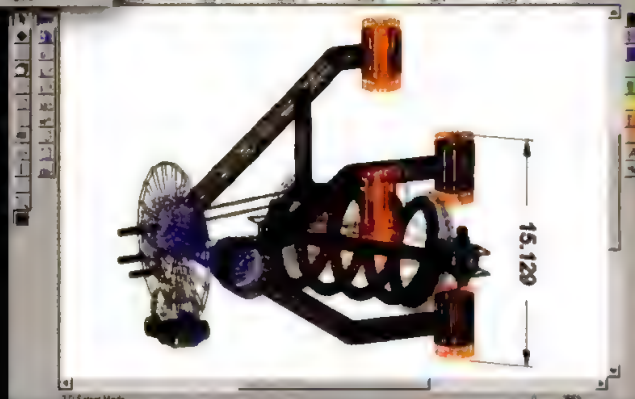
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taining information about all files on the system, ordered by the criteria that were specified for comparison. The next step is to read that file and compare each line with the previous line, looking for duplicates. It's not necessary for the entire line to match, of course, only the portion that corresponds to the selected comparison options. For example, if only the *Size* option is checked, then only the first eight characters must match. Dupeless accumulates a temporary list of two or more matching files, continuing until it comes to one that doesn't match. At that point, it displays all of the files in the temporary list as a group of duplicates—unless the *Contents* option has been selected.

FINDING IDENTICAL FILES

If the *Contents* option is selected, Dupeless must go through another step before declaring a set of files to consist of duplicates. Initially, I planned to have it simply step through the temporary list and compare each file with the first, byte for byte. If any of the files matched, Dupeless would display them as a group of duplicates, remove them from the list, and repeat the process on any remaining files.

However, this proved amazingly slow in certain situations. For example, a great many .ICO and .CUR files are exactly the same size, 766 bytes. A search on size and contents alone could easily turn up hundreds of files of precisely this size; on my own system there were more than 500. Most of them were unique, with just a few identical pairs. The number of comparisons required to determine that 500 files are unique is 249,750, and file-reading operations are among the slowest things a computer can do. I needed a way to cut down that number!

I tried using the MD5 Message-Digest Algorithm, from RSA Data Security, to create

a 16-byte digest of each file. Two identical files will always produce the same digest, though two different files could have the same digest. By sorting the list of possibly identical files based on their digests, I greatly reduced the number of full-contents comparisons required.

However, the MD5 algorithm—which is intended for encryption and security applications—performs a sequence of transformations to ensure that no information about a file's contents can be deduced from its digest,

```
function DoRecycle(const S : String) : Boolean;
VAR
  FOS : TSHFileOpStruct;
  Buff : ARRAY[0..MAX_PATH] OF Char;
begin
  FillChar(Buff, SizeOf(Buff), 0);
  StrPCopy(Buff, S);
  FillChar(FOS, SizeOf(FOS), 0);
  WITH FOS DO
    begin
      Wnd := Handle;
      wFunc := FO_DELETE;
      pFrom := @Buff;
      fFlags := FOF_ALLOWUNDO;
    end;
  Result := ShFileOperation(FOS) = 0;
end;
```

FIGURE 2: The Windows API function *ShFileOperation* is used by Dupeless to send files to the Recycle Bin.

and that files with few differences will have very different digests. These transformations were of no use to Dupeless and dragged down the speed of an already slow process.

So I replaced MD5 with a much simpler digest function that reads the first 4,096 bytes of a file and XORs them, 16 bytes at a time, with a 16-byte buffer. This is much quicker than the MD5 algorithm, especially for large files, and still substantially reduces the number of byte-by-byte comparisons needed.

THROW IT IN THE BIN!

If you do any programming for Windows 95 or Windows NT 4, you owe it to yourself to study the *ShFileOperation* API function. This function takes a *SHFILEOPSTRUCT* data structure as its single argument and returns zero for success or nonzero for failure. The most important fields of the *SHFILEOPSTRUCT* are *wFunc*, *pFrom*, *pTo*, and *fFlags*. The *wFunc* field selects from the four possible file operations: *FO_COPY*, *FO_DELETE*, *FO_MOVE*, and *FO_RENAME*. The *pFrom* field is a pointer to a character array containing the source filename or filenames, separated by ASCII NUL characters and terminated by a double ASCII NUL. If the operation is *FO_COPY*, *FO_MOVE*, or *FO_RENAME*, *pTo* specifies the destination folder or a series of destination filenames. The *fFlags* field consists of a number of bit flags that determine such things as whether "undo" information is preserved and whether a progress dialog is displayed.

As it turns out, sending files to the Recycle Bin is one of the simpler things you can do using *ShFileOperation*. Most of the *SHFILEOPSTRUCT*'s fields can be set to zero or NIL, and a progress dialog isn't really necessary. Figure 2 shows the function that Dupeless uses to recycle unwanted duplicates.

I wrote Dupeless to help clear out the deadwood on my own hard disks. The basic task was simple: Locate files that are the same, and get rid of unnecessary duplicates. But performing this simple task in a reasonable amount of time provided an interesting programming challenge. **PC**

Neil J. Rubenking is a contributing technical editor of PC Magazine. Sheryl Canter is the editor of the Utilities column and a contributing editor of PC Magazine.

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User-to-User

BY NEIL J. RUBENKING

Disabling CD-ROM Auto-Play

In response to a question in the issue of November 18, 1997, about disabling the auto-play function for CD-ROM disks, you advised editing the Registry. Why not use the check box in the CD-ROM Properties dialog? That is, in the System control panel applet, click Device Manager, select CD-ROM, click Properties, click the Settings tab, and look for the check box Auto insert notification. Using this procedure to disable the automatic run-on-insert feature is far less dangerous than using Regedit.

There is one significant difference between clearing the Auto insert notification check box and editing the NoDriveTypeAutoRun entry in the Registry. If you turn off auto-insert notification for the CD-ROM drive, then nothing happens if an auto-play-enabled data disk or an audio CD is inserted, but if an auto-play-enabled data disk is in the drive and you open My Computer and double-click on the drive's icon, the auto-play function will be invoked. If the auto-play function is disabled by your Registry change, however, the entire auto-play mechanism is ignored, and double-clicking the CD-ROM icon merely opens the disk's contents.

C. MORRIS
via the Internet

In a recent issue you suggested a way to disable the auto-play feature of a CD-ROM drive via the Registry. There's another way: The auto-play feature can be disabled if you press the Shift key when the disk is inserted.

BEN FAIRBANK
via the Internet

PC MAGAZINE: The Registry solution described in the earlier article disables the auto-play feature for all CD-ROM drives on the system. Unchecking the Auto insert notification box in the Properties dialog for a particular CD-ROM drive (Figure 1) leaves auto-play enabled but shuts off the mechanism that invokes it each time a new CD-ROM disk is inserted into that drive. The Auto insert notification check box is not always available, though. For example, my laptop computer has a PCMCIA-based CD-ROM drive that doesn't expose the handy Properties dialog box.

So you have a number of choices. If you want to retain the ability to start a CD-ROM's auto-play behavior by double-clicking on its icon in Explorer, and if your CD-ROM drive Properties dialog permits it, turn off the Auto insert notification check box. If you want to

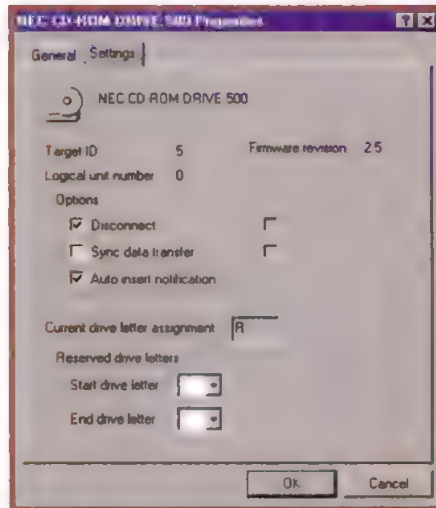


FIGURE 1: Most CD-ROM drives let you disable the mechanism that triggers auto-play when a new CD-ROM disk is inserted.

disable the auto-play feature completely, use the Registry as described in the previous article. And if you just want to suppress the auto-play behavior on a one-time basis, hold down Shift while inserting the CD-ROM.

Open with ... Revisited

I just used the tip regarding adding an Open with ... menu option, as described in your issue of November 18, 1997. It works great! I have one addition to suggest, and one question.

First, when adding the new shell, openas, and command keys, I thought it would be helpful to document how and why I was making this change. I added a new string value (named "notes") to the shell key. I then modified the value of that string to read, "See pages 302-6 of PC Magazine, Nov. 18, 1997, vol. 16 no. 20." Now the next time I use the Registry editor, I'll know where to go for the original article.

Second, I noticed that the Open with ... option is displayed at the top of the list. Personally I would prefer the option to come last, so I played briefly with renaming the shell and shellex keys to see if that would rearrange the options, but it didn't work. Any suggestions?

JOHN GARDNER
via the Internet

Your recent tip showing how to add an Open with ... menu option to all files works well, but it leads to an unfortunate side effect: Unknown files end up with two Open with ... options. The solution, of course, is to delete the HKEY_CLASSES_ROOT\Unknown\shell\

openas key. Make sure the new key is working properly before deleting the old one.

D. D. JONES
via the Internet

PC MAGAZINE: The tip explained how to copy the Windows 95 Registry entries that define the Open with ... menu item from the key for unknown files (files with no associated program) to the key for all files. The result is an Open with ... menu item on every file's right-click context menu, which makes it easy to open the same file using different applications. However, this does yield two Open with ... menu items for unknown files. If this duplication offends your aesthetic sense, you can delete the key that adds this menu item to unknown files. Launch Regedit, open the HKEY_CLASSES_ROOT key, and scroll down to the key named Unknown. Open that key, open its subkey named shell, and delete the subkey of shell named openas.

Why does the Open with ... menu item appear at the top of the context menu? Each time you right-click a file, Windows 95 builds this menu using standard items and additional items defined in the Registry. The items added to the menu are of two main types, standard operations and shell extensions. Standard operations such as Open, Open with ..., and Print are added under the shell subkey for the file type. Nonstandard operations, such as extracting the contents of a .ZIP file, must be added using a specialized DLL containing a Windows shell extension and an entry under the shellex subkey. It appears that the order of loading is:

- standard operations for all files;
- standard operations for the file type;
- shell extensions.

The Open operation is specific to each file type, naturally. It seems we have no choice—the Open with ... menu item for all files is going to come first.

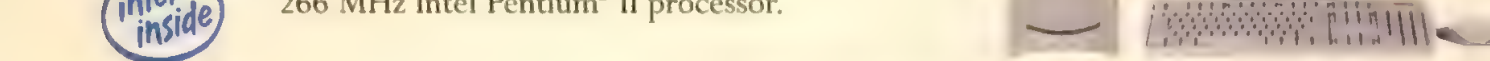
Many users wrote in to explain (or complain!) about a surprising behavior of the Microsoft Office 97 toolbar, in connection with this technique. When the Open with ... menu item for all files is present, clicking a button on the Office 97 toolbar triggers the Open with ... behavior instead of launching the file. It would appear that the toolbar activates the first context menu item rather than looking for the default item. If you rely on the Office 97 toolbar, you will have to forego the convenience of an Open with ... menu item on every file's right-click context menu.

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Ask Our Advisors

HARDWARE

Second Hard Disk Limitations

I want to install a second hard disk in my system, but I think I read somewhere that the new disk cannot be any larger than the 1GB size of my existing disk. Is this true? Can the configuration of my system impose a limit on the size of the disk that I can install? Also, what is the difference between EIDE and IDE, and should I be concerned about it in choosing the second disk? Thanks for your help.

YONI JACOBS
via the Internet

PC MAGAZINE: You should be concerned about your existing disk and configuration when adding a new hard disk, but the size of your existing disk is not one of the factors that make a difference.

The first question is whether or not your computer's BIOS provides support for Large Block Addressing (LBA), which makes it possible to use disks larger than 540MB. If your system is using a software driver to get access to the full gigabyte of your existing disk, you may want to consider upgrading your system BIOS or adding a new controller with LBA support as part of your upgrade plans. You should find a choice in your computer's CMOS configuration settings that indicate whether or not LBA support is provided; if you're not certain, contact the manufacturer or consult the system documentation.

Next, you may want to make the new disk the master and use your existing, older disk as the master on your system's secondary IDE channel, if one is available. This is because your new disk is likely to have more sophisticated controller electronics, and you may get better performance by making it the master instead of having it rely on the older disk's controller. Also, most IDE controllers use the same timing signals for both devices on a channel, so your older disk may limit the performance of your newer disk. If your system does not have a secondary IDE channel, consider adding one or getting a new controller that can provide different timing signals to two disks on the same channel.

IDE stands for *integrated drive electronics*, and the extra E in EIDE adds *enhanced*. EIDE is generally used to refer to specifications that allow for faster transfer rates and larger hard disks; any new hard disk you buy will support

EIDE features. For some of the fastest new specifications, such as the Ultra DMA modes, you'll probably need a new controller to take full advantage of the disk's capabilities, but chances are good that your existing controller will do an adequate job with any EIDE disk you may buy.—*Alfred Poor*

WORD PROCESSING

Adding a Tab to the Numeric Keypad in Word

I use the numeric keypad primarily for entering columns of numbers in Word 7. I would find it useful to have a Tab key on the keypad for tabbing from column to column and would happily give up the Asterisk key on the keypad, since I never use it to enter a formula that needs multiplication. I've tried reassigning the key using Word's Tools | Customize command, but I can't see how to assign a tab character to a keystroke, and the Customize dialog box won't accept an asterisk as a valid shortcut key in any case. Is there any way to assign a tab to this key?

CHRIS MURPHY
via the Internet

PC MAGAZINE: Assigning the key to a tab character is reasonably straightforward, but you need a macro to do it. In fact, you need two macros. Rather than assigning a key to the tab character directly, you need to create a one-line macro that inserts a tab and then use another macro to assign the first macro to the Asterisk key.

The macro for Word 7 that inserts the tab is simplicity itself:

```
Sub MAIN
Insert CHR$(9)
End Sub
```

If you want to create this macro by typing it, choose *Tools | Macro*, enter an appropriate name (such as Tab), and choose *Edit*. Word will open the macro for editing and automatically add the Sub MAIN and End Sub lines. Enter the line that inserts the tab, and choose *File | Close*. Alternatively, you can create this macro by recording it. Choose *Tools | Macro*, enter the macro name, choose *Record*, hit the Tab key, and then choose *Tools | Macro | Stop Recording*.

Next, because the Customize dialog box won't let you assign the Asterisk key, you need a macro to make the assignment. This is

also a one-line macro, but you'll have to edit it rather than record it. The one line that goes between the Sub MAIN and End Sub statements reads:

```
ToolsCustomizeKeyboard .KeyCode = 106,
.Name = "Tab".Add
```

(This assumes that you named the first macro Tab. If you used a different name, substitute that name for Tab.)

Once you've created this macro, you have to run it so that you can actually assign the Tab macro to key code 106. (And note that the key code refers to the Asterisk key on the numeric keypad only. You will still enter an asterisk when you type Shift-8. In fact, you'll still be able to type an asterisk from the numeric keypad if you hold the Shift key down when you hit the numeric-keypad asterisk.)

You can run the macro without even saving it by choosing the *Start* button in the macro toolbar. Once you've run it, test the Asterisk key to make sure the key enters a tab. You can then close the macro without bothering to save it, since you won't have to run it again. (But be sure to give the *File | Save All* com-

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PCTech Ask Our Advisors

mand to save the changes stored in the Normal template.) If you ever want to reset the key to entering an asterisk, you'll have to run another macro. The macro for resetting the key is identical to the first one except that you need to replace .Add with .Remove.

You can do the same thing in Word 97 using almost the same steps. To start recording a macro, choose **Tools | Macro | Record New Macro**. To stop recording, choose **Tools | Macro | Stop Recording**. To create a macro, choose **Tools | Macro | Macros**, enter a name, and choose **Create**. In Word 97, Word will enter a Sub and an End Sub statement for you, but the Sub statement will include the macro name. If you've named it RunTab, for example, the statement will read Sub RunTab(). In addition, Word will add several comment lines, including the date the macro was created and who created it.

The biggest difference, however, is the macro language. In Word 97, the command for entering a tab in the first macro is

```
Selection.TypeText Text:=vbTab
```

The two-line macro for attaching the Tab macro to the Asterisk key is

```
CustomizationContext =  
NormalTemplate  
KeyBindings.Add KeyCode:=  
BuildKeyCode(106),  
KeyCategory:=wdKeyCategoryMacro,  
Command:="Tab"
```

And the two-line macro for resetting the Asterisk key to its normal behavior is

```
CustomizationContext =  
NormalTemplate  
FindKey(BuildKeyCode  
(arg1:=106)).Clear
```

Instead of the key code 106 to designate the Asterisk key, you can use the key code vbKey-Multiply in both Word 97 macros.

—M. David Stone

SPREADSHEETS

Conditionally Coloring Cells

I would like to create a table in Excel 97 using Excel's conditional formatting feature to color cells automatically depending on their value. Unfortunately, I can specify only three conditions, and I need a total of seven formats, including the default. Is there any way to work around this limitation?

NICOLAI MICHEL
via the Internet

I am using Excel to organize the weekly work schedule. Since the schedule has a lot of changes each week, it is very helpful for me to color-code different cells. For example, a cell without an employee name in it will have a background color of yellow and a cell with a question mark in it will have a background color of green. I do this manually now to help me keep track of open shifts or questionable coverage. Is there a way to have Excel do this automatically whenever a question mark is in a cell and when the cell is blank?

LYNN PACKER
San Diego, California

PC MAGAZINE: With a Select Case structure that tests the Value property of cells, you can easily expand Excel's built-in conditional formatting capability. Use a For Each...Next loop to apply your Select Case tests to each cell in the range you're interested in.

The code in Figure 1 applies seven different foreground colors, depending on the cells' values. The procedure begins by setting up a For Each...Next loop to test every cell in the range named Table. As the first step in the loop, the code checks whether the cell has a numeric value. If it does, the code proceeds into the Select Case structure. If not, it drops down to the Else clause, where the cell is assigned the default color (the cell's ColorIndex property is set to the built-in constant xlAutomatic). The IsNumeric test is essential because without it a text value would cause the first test in the Select Case structure to generate a type mismatch error.

Within the Select Case structure, we simply set up seven conditions and apply different ColorIndex values according to which condition is met.

As to the question posed in the second letter: In Excel 97, you can use the built-in conditional formatting feature to change a cell's background color if it contains a question mark or is blank. That's because the built-in feature can handle up to three conditions, and here we're concerned with only two. But there is one important thing you should know: In the Conditional Formatting dialog box, you can't directly stipulate that a format be applied when a cell is blank. Instead, you have

to tell Excel what to do when the cell you're interested in equals some other specified cell—whose value may be blank. Choose a cell off somewhere in a corner, make sure it's blank, then specify as your condition that the cells you care about be equal to that remote blank cell.

```
Sub ConditionalFormat()  
  For Each cell In Range("table")  
    If IsNumeric(cell.Value) Then  
      With cell.Font  
        Select Case cell.Value  
          Case Is < 125  
            .ColorIndex = xlAutomatic  
          Case 125 To 249  
            .ColorIndex = 3  
          Case 250 To 374  
            .ColorIndex = 5  
          Case 375 To 499  
            .ColorIndex = 4  
          Case 500 To 624  
            .ColorIndex = 7  
          Case 625 To 749  
            .ColorIndex = 53  
          Case Is > 749  
            .ColorIndex = 46  
        End Select  
      End With  
    Else  
      cell.Font.ColorIndex = xlAutomatic  
    End If  
  Next cell  
End Sub
```

FIGURE 1: This Excel 97 macro applies seven different foreground colors, depending on cells' values.

To set up the conditions in the second reader's letter in Excel 95, you can use the following code:

```
Sub BackgroundColors()  
  For Each cell In Range("a1:a10")  
    If Not IsError(cell.Value) Then  
      With cell.Interior  
        Select Case cell.Value  
          Case Is = Empty  
            .ColorIndex = 10  
          Case Is = "?"  
            .ColorIndex = 6  
          Case Else  
            .ColorIndex =  
              xlAutomatic  
        End Select  
      End With  
    Else  
      cell.Interior.ColorIndex =  
        xlAutomatic  
    End If  
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End Sub
```


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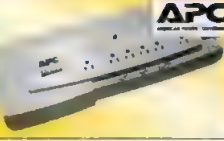


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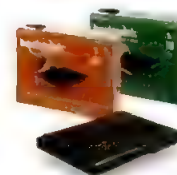
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In this macro, we're testing an absolute range (A1:A10). Using a range name would be preferable, because that allows you to relocate the test range without having to rewrite the code. But you can do it either way. Also, for the sake of variety our code first checks whether the cell being tested holds an error value. If it does, we hop over the Select Case business and set the default background color. Otherwise, we move into the structure and check for blankness or a question mark. If either value is found, we set the Interior.ColorIndex property. If neither is found, Case Else puts in the default value.

How do you know what the appropriate formatting properties are for your application? By using the macro recorder. Record a macro setting each format you want, stop the macro, look at the code, and see what the recorder hath wrought—which in most cases will be more than you need. For example, when you record the act of setting a cell's background color, the recorder sets the Interior.Pattern and Interior.ColorIndex properties, as well as Interior.ColorIndex. It does no harm to include all this stuff in your Select Case macro, but you can usually figure out which property you really need to set and simply exclude the other details.

Once you've got a Select Case structure that sets your conditional formats as you want them, you need a way to make those settings take effect whenever you change the affected range of cells. In Excel 97, this is simple:

1. Press Alt-F11 to display the Visual Basic editor.
2. In the Project Explorer window, find an entry for the sheet you're working with. (For example, look for Sheet1 if the cells you're formatting are on that sheet.) If you don't see the Project Explorer window, press Ctrl-R.
3. Double-click the sheet entry in the Project Explorer window.
4. Above the code window, you'll find two drop-down lists. In the list on the left, choose *Worksheet*. In the list on the right, choose *SelectionChange*.
5. A procedure template for *Worksheet_SelectionChange* now appears in the code window. Between the *Private Sub* line and the *End Sub* line, type the name of your conditional formatting procedure.

For example, if your conditional formatting procedure is called *ConditionalFormat*, your *Worksheet_SelectionChange* procedure would look like this:

```
Private Sub Worksheet_SelectionChange  
    Change(ByVal Target As Excel.Range)
```

```
Public Function Text2Date(strMMDDYY)  
    '*****  
    ' Public Function Text2Date(strMMDDYY)  
    ' Convert text in the format MMDDYY to a date type  
    '*****  
    Dim strDate As String, dtmDate As Date  
    strDate = Left([strMMDDYY], 2) + "/" + Mid([strMMDDYY], 3, 2) + _  
        "/" + Right([strMMDDYY], 2)  
    dtmDate = CDate(strDate)  
    Text2Date = dtmDate  
End Function
```

FIGURE 2: The *Text2Date* function can be used to convert a date string in the format MMDDYY to a date data type.

```
ConditionalFormat  
End Sub
```

In Excel 95, you can make your conditional formatting macro run automatically by creating an *Auto_Open* procedure that looks like this:

```
Sub Auto_Open  
    Application.OnEntry =  
        "Conditional_Format_Macro"  
End Sub
```

where *Conditional_Format_Macro* is the name of your conditional formatting macro. Be sure to include the quotation marks. (If your workbook already has an *Auto_Open* macro, simply add this line to it.)

—Craig Stinson

DATABASES

Converting Text into Dates

I'm having a problem with Microsoft Access. With Alpha Software's Alpha5 and Lotus Approach, I had no problem converting dates formatted as MMDDYY or YYMMDD in a text field to MM/DD/YY dates in a date field. I did this using a combination of the Left, Right, and Mid functions, to create an expression to re-construct the string in the proper sequence with the "/" separators I needed.

How can I do this in Access?

GARY RABENKO
via the Internet

PC MAGAZINE: Once you have the data in a text field in proper short date format (MM/DD/YY), you can simply modify the table design, changing the data type to Date/Time and the format to Short Date; Access will handle the conversion for you. To get to that point, I suggest three steps. First, get the data in a text field in its original MMDDYY format, probably through importing. Second, use an UPDATE query to insert the required

"/" characters so that the dates will be in the proper short date format. Third, modify the table design as mentioned above: Change the data type to Date/Time and the format to Short Date.

The UPDATE query should look like this, assuming the field is named *TxtFld* and the table is named *Table*:

```
UPDATE Table SET TxtFld =  
    Left([TxtFld],2)+"/"+Mid([TxtFld],3,  
    2)+"/"+  
    +Right([TxtFld],2);
```

Should you need a function to perform this conversion on a single value in your own code, the one in Figure 2 should do. You pass it a text field in MMDDYY format, and it performs the conversion and returns a date type. You will, of course, need to modify it if you choose a format other than MMDDYY.

—Sal Ricciardi

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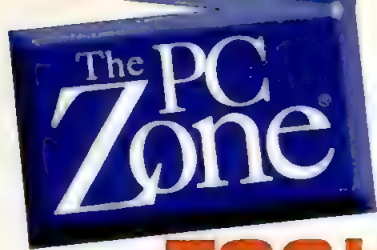
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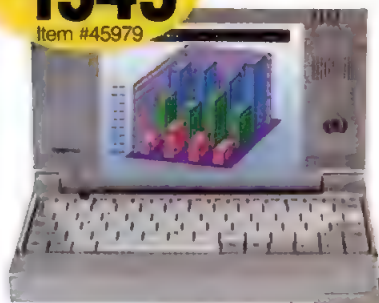
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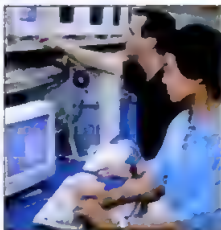
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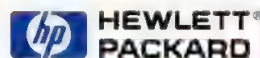
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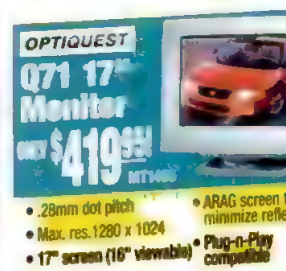


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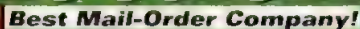
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4130T, 4131T - 16MB KII #217915-001	69
Compag 1MB Video #213922-001	29

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DIMMS (168 pin)

SDRAM - DELL & GATEWAY, INDUSTRY STANDARD

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3.3V 66MHz 54	79
3.3V 32MHz 89	159
3.3V 32MHz 249	329
3.3V 128MHz 599	749
3.3V 256MHz 1290	1439

INDUSTRY STANDARD DIMMS

1.2V EDO 70 120 240 512	
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ECC DIMMS

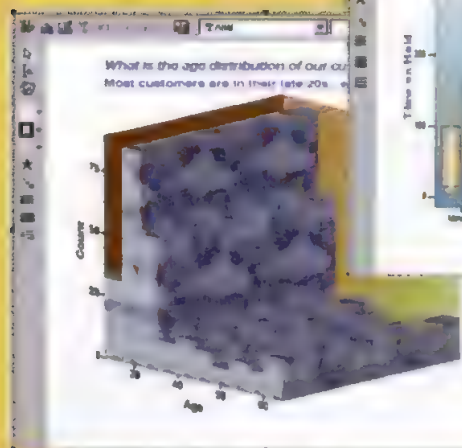
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CACHE MEMORY

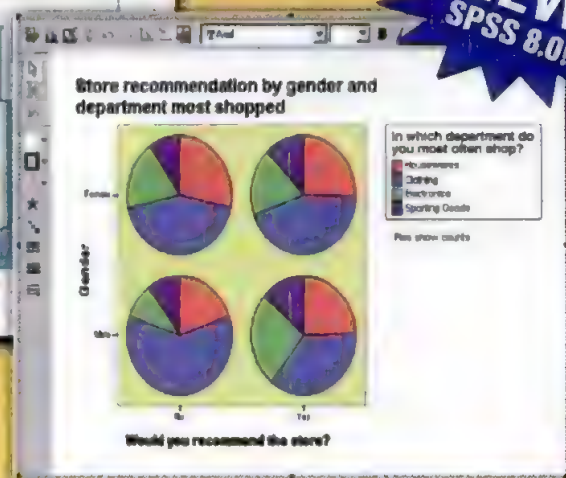
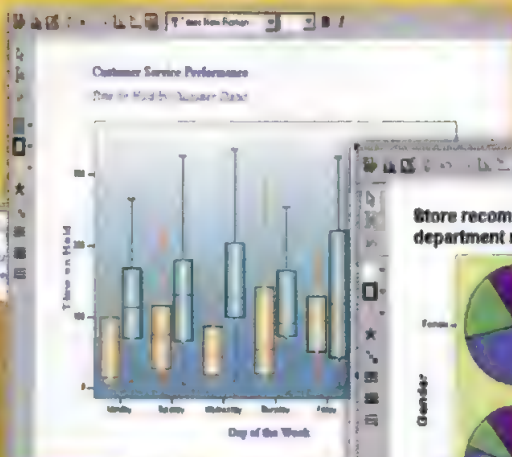
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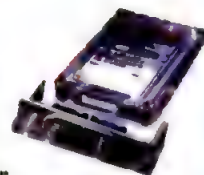
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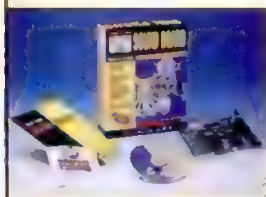
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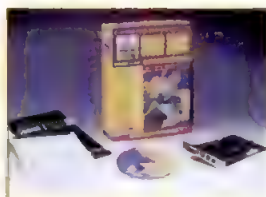
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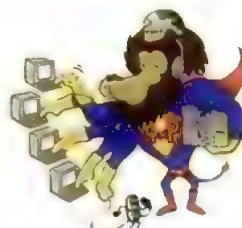
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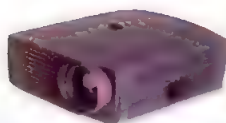
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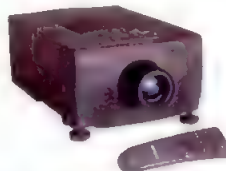
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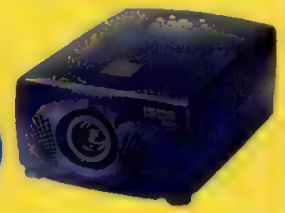
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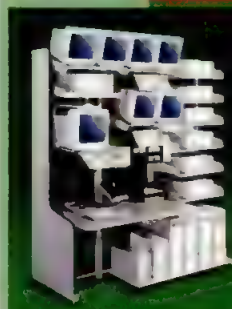
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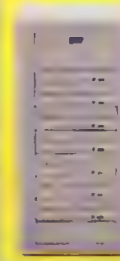
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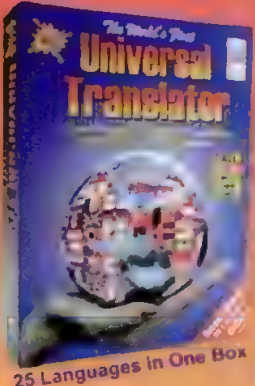
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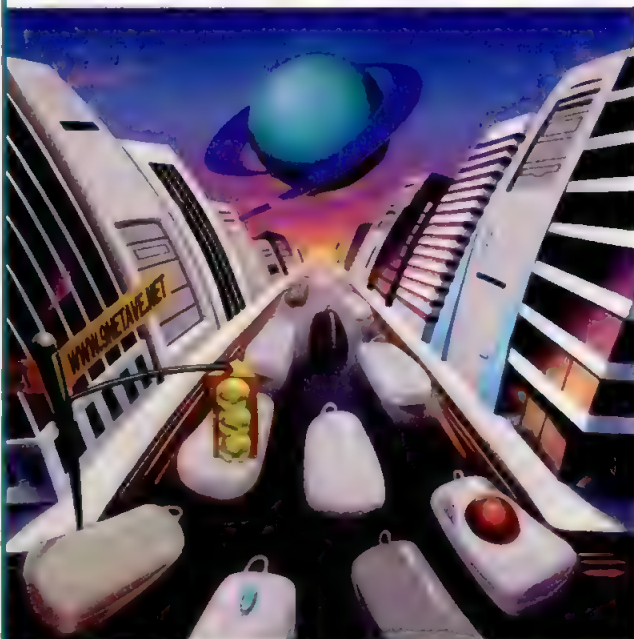
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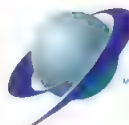
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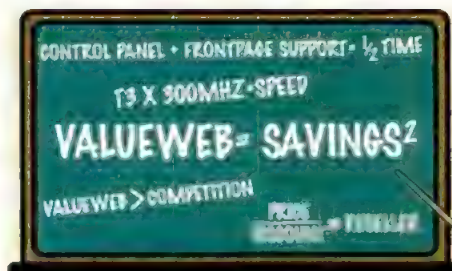
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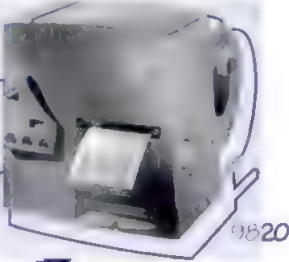
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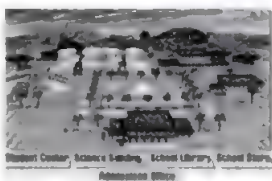
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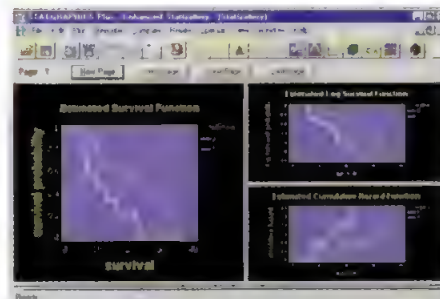
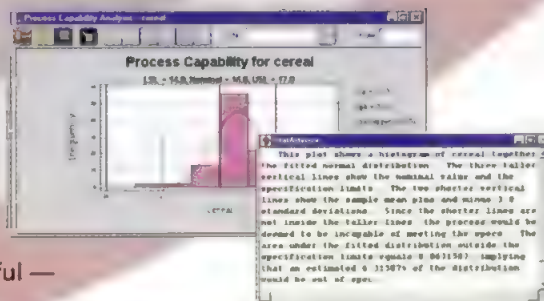
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After Hours

Racers Ready?

Sunday drivers or Indy enthusiasts will enjoy these racing sims.

By T. Liam McDonald

Racing simulators are generally either detail-perfect down to the physics of each turn or designed to invite you to hit the track and floor the accelerator. The best balance realism and playability.

We took seven games out to the *PC Magazine* test tracks. Each was run extensively on a Pentium/200 with 32MB of RAM, a Diamond Monster 3Dfx card, and the Thrustmaster NASCAR Pro Racing Wheel. We also ran performance checks on PCs ranging from a Pentium/90 with a Rendition card to a Pentium/133 with a 3Dfx/Rendition combo. (F1 Racing Simulation, a promising new release from UbiSoft, was not available for review.)

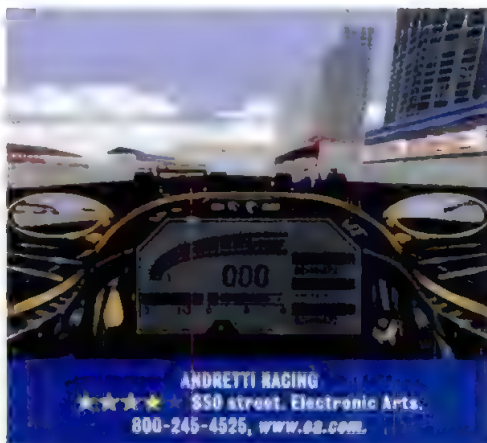
Andretti Racing

When Jeff, Mario, and Michael Andretti sit down with a team of programmers to create a game, it's reasonable to expect something exceptional. Electronic Arts' Andretti Racing, recently brought from the console to the PC, is a well-rounded, fun package.

Andretti lets you race both Indy and stock cars across 16 real-world and fantasy circuits. No other game offers both

kinds of racing. This versatility makes for an interesting game, but it means that Andretti captures neither racing style with the high degree of veracity demanded by some hard-core PC racers.

Make no mistake: The cars handle well and are a challenge to race. You can tweak tire compound, gear ratios, down force, and fuel load. Pit crews are overly efficient, although crew control doesn't approach the depth in CART Precision Racing. Handling is a notch above arcade and a notch below simulation, making it a satisfying diversion for people



who want the feel of the real thing without a hard-core simulation's extreme effort and learning curve.

Andretti is the best-looking racing game around. On a Pentium/133 with 16MB of RAM (the minimum specs) and a 3Dfx card, it looks super.

Effects such as sun glare and weather greatly enhance the game's feel, and both tracks and cars are outstanding. Even with many cars on the track, the frame rates remain fluid. On-screen drivers, challenging yet sensible, don't make glaring mistakes like the ones in CART Precision Racing. The game supports up to eight players via IPX.

Andretti Racing is a slick, fun package balancing realism and playability. For gamers who want a taste of two kinds of racing, it's a solid bet.

CART Precision Racing

Grand Prix II and CART Racing, from Papyrus, cast long shadows over any publisher trying to bring a realistic racing game to the PC. Microsoft's CART Precision Racing (CPR) takes on these classics; despite a few missteps, it's a very promising package.

The interface is intuitive and detailed. The garage has a logical layout, audio cues to explain complex settings, and a "smart" mechanic who asks performance-based questions and modifies your car automatically. The game has settings for each of 17 courses, along with a full roster of 1997 racers and stats. But although the driving-school and player-info section holds lots of useful information, a clumsy interface hampers it.

CPR's graphics, which sup-

port 3-D acceleration via Direct3D, were quite sharp during test drives. Note that although Microsoft specifies at



least a Pentium/60 with 16MB of RAM, we found that on anything less than a Pentium/133, CPR doesn't clock high-enough frame rates to be drivable. But with a fast system (32MB of RAM helps) and a good 3-D card, it looks outstanding. The scenery is much sharper than in CART Racing, although the cars are less detailed. But frame rates take a dive when a dozen cars are on the screen.

Racing action is fast and entertaining, with cars handling far more forgivingly than in CART Racing. More troublesome is the weak AI, which lets drivers regularly ram you from

INSIDE

TYPING TUTORS

We look at two software programs that help your fingers fly over the keyboard. *Page 330.*



MEN IN BLACK, PART II

The big-screen hit comes to the PC in this action game. *Page 332.*

After Hours



behind and drive quite poorly.

Microsoft definitely needs to address this issue, but the company has done everything else in CART Precision Racing so well (especially for a freshman effort) that the game entertains mightily. It might appeal to those who find the *Über*-realism of other simulators too much to handle.

Manxx TT SuperBike

MotoRacer raised the bar for motorcycle racing games. Its incredible graphics, diverse bikes, numerous courses, and scorching action made it a standard of comparison for that kind of game. Sega of America's Manxx TT SuperBike takes on similar material but enjoys far less success.

Manxx pits high-performance motorcycles against each other on the open road. Adapted from Sega Saturn, it looks every inch the console game. The eight bikes all have very similar, arcadelike handling and a preternatural ability to hold the road and avoid destruction. A few play modes are available, but they do little to mix up the lackluster game play. PC mode should be more difficult than arcade mode, but it's not. Time trials are rather lifeless, and we found network play via TCP/IP to be unstable.

Graphically, Manxx looks

good if not great. Support for the 3Dfx board gives decent frame rates on higher-end machines (Sega lists a Pentium/90 with 16MB of RAM as the minimal system), but 2-D mode is hopeless. Tracks are too short to be interesting. The most egregious error of all: There are only two tracks

in the package, though you can run both in reverse for a faintly different experience.

Manxx TT SuperBike may appeal to arcade fans who like the familiar and simple controls, but there's no question that MotoRacer is superior in every way: visuals, game play, control, and value.

Need for Speed II SE

Need for Speed II lacked some of the magic that had made the original game so much fun. The sense of driving the finest cars at absurd speeds on open roads (while evading the police) had been the allure of Need for Speed, but the sequel didn't keep the long tracks and the cops. Electronic Arts' Need

for Speed II SE (Special Edition), recaptures some of the magic but still misses some important elements.

The most prominent enhancement is support for 3Dfx-based video accelerator cards. Like its predecessor, NFS II SE specifies at least a Pentium/90 with 16MB of RAM; but on less than a Pentium/166, the frame rate dips, requiring users to turn off most of the graphics features that enticed them in the first place. On the right system the game soars: Even with eight detailed cars running on the tracks, landscapes flying by and objects zooming overhead, game play remains smooth.

Enhanced graphics are the main allure. Over seven main tracks and one hidden track (type *HOLLYWOOD* at the main screen to find it), there's some splendid scenery, from the Himalayas to a Hollywood back lot. NFS II SE has added some modest off-road stretches, and you can mirror

each track and run it in reverse. And the game has four new cars in addition to the eight in NFS II: the Ferrari 355 F1, Ford Indigo, Ford Mustang



Mach III, and Italdesign Nazca C2. Each performs a bit differently in terms of handling and top speed.

More disappointing is the lack of other drivers or police. Nevertheless, this is a slick production and a fun game for speed enthusiasts.

SODA Off-Road Racing

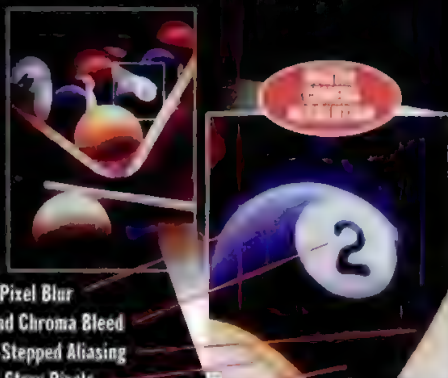
No, Sierra On-Line's SODA Off-Road Racing doesn't involve driving monster trucks fueled by soft drinks. It's a realistic simulation licensed by the Short-Course Off-Road Drivers Association—the folks who race trucks in muddy circles on The Nashville Network. It's a bit more realistic and challenging than Monster Truck Madness, but in some ways a bit less fun.

You can race a two-wheel-drive pickup truck, a larger four-wheel-drive truck, or a small 150-horsepower buggy. Each has detailed handling properties, making control a challenge for the inexperienced. Hard-core fans can modify tires, springs, cambers, shocks, weights, gearing, and other specs. The game doesn't



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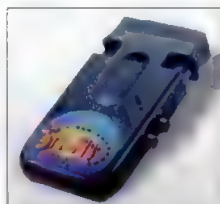
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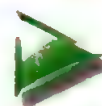
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After Hours

explain any of this particularly well (unlike CART Precision Racing), leaving the novice with vehicles that are tougher to control than a bucking bronco and with garage options that can be downright puzzling.

But for those willing to learn the ropes, the reward is some great racing fun and action. The 12 tracks are spread across tropical, desert, and forest terrain for a good mix of challenges. The game supports 3-D, though graphics are decent without 3-D acceleration.

The problem is that the game supports only Rendition 3D boards, leaving 3Dfx owners with mediocre visuals. Sierra specifies at least a Pentium/90 with 16MB of RAM, and we saw decent frame rates with a Pentium/133. But gamers without Rendition cards may be disappointed.

SODA is a bit more "serious" than Monster Truck Madness, so there's no silly fun. But the product includes an excellent track editor, which will stretch out this game's life indefinitely.



Streets of SimCity

Like SimCopter, Maxis's Streets of SimCity attempts to give SimCity 2000 fans a new way to enjoy their favorite game. But although it succeeds as a supplement to SimCity, it fails as a standalone game.

Streets of SimCity is packaged as a fun rather than realistic game. This description is accurate, since the re-creation of driving is poor. Cars handle sluggishly no matter what chassis, engine, or tires you use, and there's no sensation of speed. Frame rates were quite poor on our top system despite the 3Dfx support, even with some of the graphics



detail turned off. The minimum system requirements are steep—a Pentium/166 with 32MB of RAM—but we still found distance rendering to be poor, with fog replacing detail.

Five stories connect missions that involve delivering packages and killing bad guys. Deliveries earn cash for guns, missile launchers, mine layers, armor, and so on. The object is to carry out tasks while driving around the city and avoiding police and civilian vehicles. But these tasks are often confusing or difficult. The map gives few cues as to where to go next, and at times it abandons you to the whims of enemy drivers. Delivering packages is more frustrating than fulfilling.

The main appeal is not the game play or even the custom racecourse maker but the ability to drive around cities that you've built. You can load any of your SimCity 2000 cities, and the game shows the buildings in admirable detail. As a driving/action game, Streets of SimCity leaves a lot to be desired, but as a tour of your virtual city, it can be fun.

Test Drive 4

Whereas Need for Speed II SE improves on many features in its previous versions, Test Drive 4 seems to magnify the worst elements of this console adaptation. There was hope that Accolade would learn from the mistakes of Test Drive Off-Road. Sadly, we find it has not.

Things don't bode well right from the main menu, which has no mouse support. Also, settings (controllers, sound, graphics) are reset each time you start the game. The system specs are not realistic:

a Pentium/90 with 16MB of RAM. A 3Dfx card is mandatory for getting the best visuals, and a Pentium/133 with 32MB of RAM would be a good choice.

The game renders buildings and cars well, but landscape is only average. Moving objects such as airplanes look good but tend to pop in and out, and distance rendering is a huge problem. Terrain graphics are unforgivably bad and distracting: It's hard to stay on the road while watching the Golden Gate Bridge being drawn.

The cars have no discernable differences, a design flaw that places the game in the arcade camp. The dashboard is badly botched, with poor representation of gears, no shift light, and, unbelievably, no speedometer.

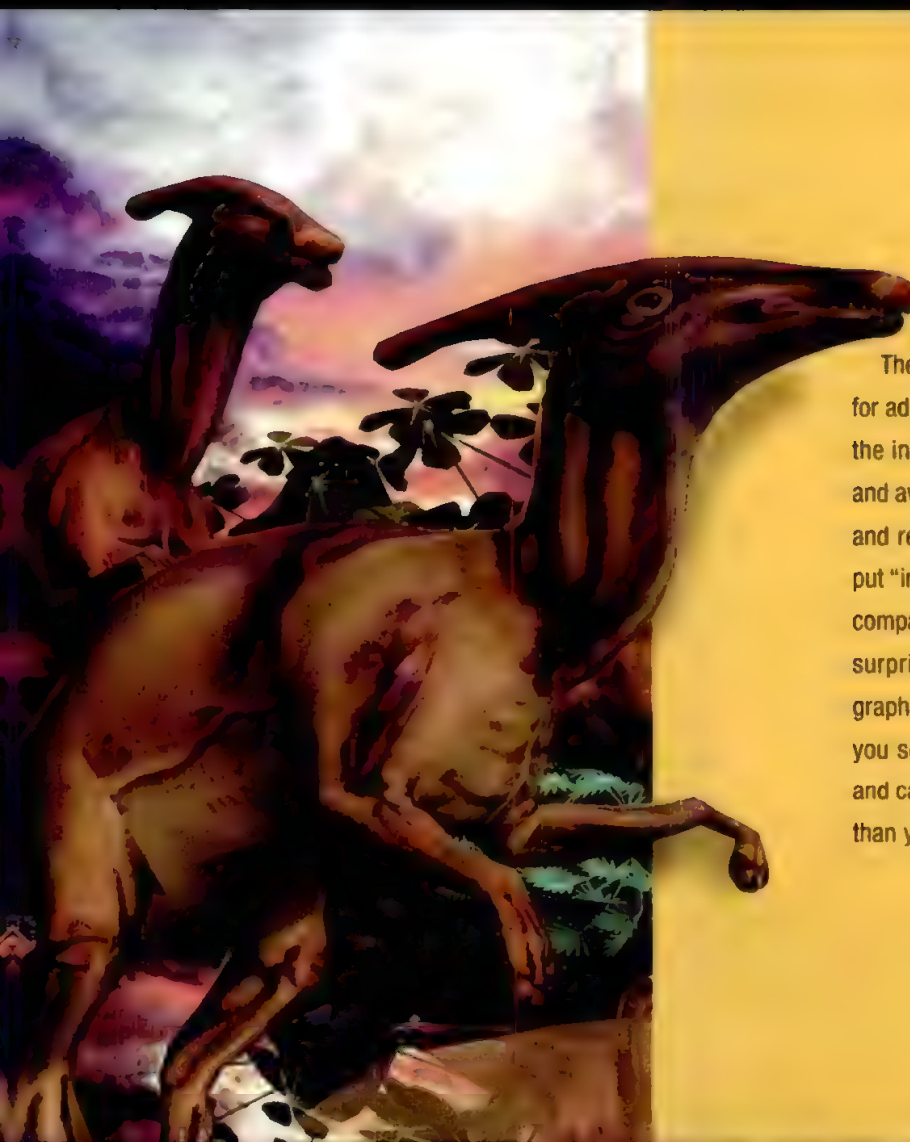
The six tracks are short but interesting. The game has ten cars: five modern sports cars and five muscle cars from the past, such as the '69 Camaro. And unlike Need for Speed II SE, Test Drive 4 does have traffic and cop cars, which certainly add to the challenge.

Test Drive 4 has some elements that could make it a good game, but too many small flaws pile up and drag it down.



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Typing tutorials help you learn the basics or brush up on your skills.

By Jennifer Triverio

Do visions of seventh-grade typing class—complete with manual typewriters cruelly devoid of letters on the keys—still bring back bad memories? Take heart, since today's PC-based typing tutorials are intuitive and fun. And best of all, they work. One thing hasn't changed since seventh grade, though: You need to practice, practice, practice.

We tackled the keyboard with Mavis Beacon Teaches Typing 8 and Typing Tutor 7, both designed for users ranging from the beginner to the touch typist.

Mavis Beacon Teaches Typing 8

Those who have had even an occasional glance at a software best-seller list know that Mavis Beacon has ruled for years. There's a reason for this: Mindscape's Mavis Beacon Teaches Typing is well designed and engaging, with convenient pop-up menus and easy-to-follow lessons. Of course, the games don't hurt, either.

You can select a variety of settings, such as font, background music, and keyboard (standard or the Microsoft Natural Keyboard). The next step is the test, which evaluates your strong and weak points and determines whether you should start at the

beginning, intermediate, or advanced level.

Lessons have you type key combinations to familiarize you with the keyboard; you build up to typing words, sentences, and paragraphs. For beginners, transparent hand overlays on the on-screen keyboard type along with you and aid in correct finger placement. Mavis Beacon, the host, offers tips and words of encouragement.

Beginners will appreciate the fact that there is no timer that can run out as you frantically try to type a few more words: You type until you have completed the lesson, and then the program tallies your words per minute. (You can also choose not to be timed.) As you advance through the lessons, you can check your

improvement in the progress section, which charts your speed and accuracy.

The practice area offers texts ranging from *The Call of the Wild* to the Bill of Rights for working on your technique.

When you want to take a break, the seven games—with names such as Penguin Crossing and Road Race—offer fun

You begin by selecting your typing level—beginner to full touch-typist—and then you dive into the lessons. The lesson area focuses on the “home row” first and progresses to those hard-to-reach keys such as Z, then to words and sentences.

The program encourages you to watch the on-screen

keyboard for guidance, but we found it to be too small and awkwardly located above the test material that you type. The hand outlines over the colored on-screen keyboard (one color for each finger) are very hard to see and thus almost impossible to follow.

The lessons are timed—a red bar at the bottom of the screen

while emphasizing typing skills. Also worth a look are the videos, which cover topics such as ergonomics.

Typing Tutor 7

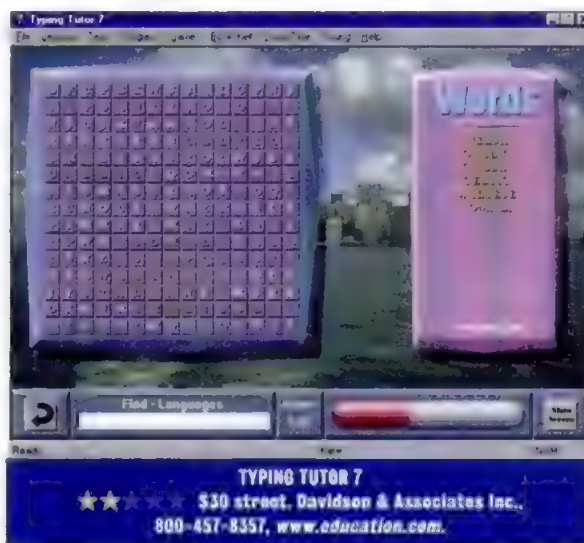
Davidson & Associates' Typing Tutor 7 has been in the unenviable position of playing catch-up to Mavis Beacon for years. Unfortunately, it still falls short.

Right from the start, Typing Tutor 7 isn't as easy to use as Mavis Beacon. You have to specify a folder on your hard disk before you can save your work; if you just hit the save button after you type in your name, you get an error message.

shows how much time you have left—and you can't help but get a sinking feeling as you try to finish before time runs out. But alas, you can't finish a lesson in the allotted time: When you get to the end of the text, another line pops onto the screen, and this process continues until time runs out. It does not do much to boost morale.

The practice area consists of text selections and dated video clips of Billie Jean King, FDR, and others. The three games are rather uninspiring, including a word search game that has no discernable link to improving typing skills.

Typing Tutor can help you improve your skills, especially if you are already a fairly good typist and don't need a lot of visual aids, but Mavis Beacon Teaches Typing is clearly the better choice.



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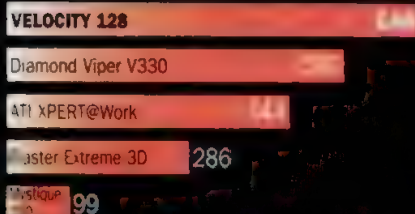
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Men in Black

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You begin the game as James Edwards, investigating a burglary at a New York apartment. After a series of hand-to-hand battles and gunfights in



which you aim to show your prowess, you're invited to join the MiB. Brought to MiB headquarters, you are reborn

as Agent J. The black suit is now standard, as is the ability to wield eight pieces of futuristic weaponry such as the Noisy Cricket.

At headquarters you can choose to continue playing as Agent J, or you can select one of the other characters: Agent K or "Woman in Black" Agent L. They have unique abilities and an array of witty retorts characteristic of their personalities. Their street smarts and weapons proficiency come in handy, as there are many difficult puzzles to solve and plenty of

aliens to vaporize.

The game, which has four levels, is darker in theme and look than its cinematic proto-

type, though it has bright, comic book-style montages sandwiched between levels.

The game has polygon-based graphics that enhance the action but are also cause for some annoyance. And a variety of camera angles make spatial relationships, including distance, hard to judge. While you're jumping over an Amazonian gorge, for example, it's difficult to tell whether the rocks are moving from left to right or up and down. Frustrating, when death is your reward for a slip-up.

Although the game would benefit from a tighter story line, it's the closest you'll get to wearing those MiB Ray•Ban sunglasses without giving up your home life.—Roderick A. Beltran

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Coming Up

What's in the Next Issue of *PC Magazine*

Time to Upgrade Your PC?

Don't continue suffering with inadequate hardware that keeps you waiting and worrying. We'll help you decide whether it's smarter to upgrade the system you have or just flat-out buy a new PC. We pit some "dated" PCs with peripherals and sub-system upgrades against new PCs and see what happens.

Essential Hardware Accessories

Gadgets, gadgets everywhere. There are hundreds of products out there to make your computing experience more productive and more enjoyable. From input devices to travel aids, from multimedia add-ons to gamer gear, we've found more than 150 of the hottest accessories around.

Removable Storage

With Internet downloads, digital photos, scanned images, and all those applications and games, hard disk space is at a premium. And many times you need to shuttle files between home and office or share large files with a colleague. PC Magazine Labs tests 14 of the newest removable drives that give you almost unlimited space for all your stuff.

Free Utility

Have some fun! PC Ladder creates word games that challenge your vocabulary and ingenuity.



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Pentium II Systems MMX FROM 1239⁹⁹!

Tiger's Most Advanced Systems—Featuring Intel Pentium II MMX Processor and More!



Looking for the world's fastest computer for an unbeatable low price? You found it! Tiger has the world's fastest processor—the revolutionary Pentium II—enveloped by a state-of-the-art motherboard and case, laced with luscious multimedia extras for sensational effects, and

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Item#	Processor	Memory	HD/CD	Video Card	Lease/mo.	Price
A13-S2 38	Intel Pentium II 233MMX	32MB	4.3 GB/32X	ATI RAGE II PCI	\$44*	\$1,239.99
A13-S2 4C	Intel Pentium II 266MMX	32MB	4.3 GB/32X	ATI RAGE II AGP	\$50*	\$1,439.99
A13-S2 5B	Intel Pentium II 300MMX	64MB	6.4 GB/32X	ATI RAGE II AGP	\$61*	\$1,749.99
A13-S2 7A	Intel Pentium II 333MMX	64MB	6.4 GB/32X	ATI RAGE II AGP	\$70*	\$1,999.99

*Call for leasing. Sorry but as prices are always changing, we do not offer price protection in the event prices rise or fall. Call for details and warranty information.

DVD Player And Internet PC: \$999⁹⁹

Amazing Audio And Video!



The future of entertainment is here. New PC Cinema includes a DVD player and powerful PC to boot! Compare: the VHS tapes you're watching now give you between 250 and 270 lines of resolution. PC Cinema's DVD player delivers an incredible 500 lines of resolution—that's double the detail and clarity! And unlike other DVD systems, PC Cinema is fully upgradable—so you'll be ready for possible future upgrades like DIVX, DTS or even writable DVD-ROM. Put your DVD—and your Internet PC—in the living room; after all, they belong together! PC Cinema is the complete family entertainment system at an affordable price! PC Cinema leads the way with the highest quality DVD technology. It's the crispest, sharpest, most lifelike image you've ever seen! Connects quickly and easily to your TV and enables you to surf the Net, watch movies, play games, work on your PC! Add more memory, add a printer, scanner, digital camera or digital video firewire connection, MIDI instruments and more. All with great video and sound!



Hollywood's blockbuster hits are now available in superior-quality DVD format!

Connects to your existing TV and Stereo!

A13-PCC1	AMD K6-200 MMX PC Cinema		\$999.99
A13-PCC2	AMD K6-233 MMX PC Cinema		\$1399.99

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PR200, P233 PCs: FROM \$479⁹⁹

AMD-K6 MMX, IBM 6x86, Pentium MMX. Easy-To-Assemble!

Here at Tiger, many customers have asked us for variations in memory and hard drive sizes on our stock systems; in fact, we've found that memory and hard drive size are the number-one variable in today's system purchases. So we proudly introduce our all-new "Customize-It-Yourself" system! We've got six great systems to choose from—you simply pop in your hard drive and memory (see prices below), load your choice of operating system—and it's ready to run! We pack it with the best technology, assemble it, test it and ship it to you for final customization. After all, you know how much hard drive space and memory you need. And these systems are fully assembled and tested.

Six Great Systems To Choose From!

Choose just the right processor for your kind of work from the best in the industry... an AMD-K6 MMX... the IBM 6x86... a Pentium MMX... or the speed-burning Pentium II. These are complete, fully assembled and full-featured multimedia systems. These systems include a top-speed 24X or 32X CD-ROM drive, 56K fax-modem with voice, 16-bit audio adapter with Yamaha wave table and 3D sound, S3 VIRGE 3D or ATI AGP RAGE II Pro video with a full 4MB of video memory, premium Windows 95 keyboard, PS/2 mouse, digitally tuned stereo speakers, microphone, cables and more—all installed, and 100% tested. Simply add a monitor, hard drive and memory for a ready-to-run system. Then power up and enjoy the savings!

ADD MEMORY Kit includes 1 16MB DRAM DIMM

Item #	Memory	Size	Price
A13-ME 1	SDRAM DIMM (1 module)	16 MB	\$34.99
A13-ME 2	SDRAM DIMM (1 module)	32 MB	69.99
A13-ME 3	SDRAM DIMM (1 module)	64 MB	\$219.99

ADD A HARD DRIVE...

Item #	Manufacturer	Capacity	Price
A13-HD 1A	Seagate UDMA	1.7GB	\$149.99
A13-HD 3A	Western Digital UDMA	3.2GB	\$199.99
A13-HD 4A	Western Digital UDMA	4.3GB	\$229.99
A13-HD 6A	Western Digital UDMA	6.4GB	\$299.99

PR200, 233, 266, 300, and 333 MHz!

All six of our Customize-It-Yourself PCs feature an advanced Case!

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3D Video With 4MB Memory!

YOU GET ALL THIS:

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- S3 VIRGE 3D Video With 4MB
- Premium Keyboard
- PS/2 or Microsoft IntelliMouse
- 512KB Pipelined Burst Cache
- USB Ports
- 4 PCI and 4 ISA Slots on ATX (4 PCI, 2 ISA and AGP slots on Pentium II)
- Infrared Port
- 3.5" Floppy Drive, 2 Serial, 1 Parallel Port
- 6-Bay or 9-Bay Case
- 3 Cooling Fans (Pentium II has 4 Fans)
- Motherboard, and Floppy Drive Pre-installed and Tested

Tiger Assemble-It-Yourself Multimedia Kits

Item #	Processor	MB	HD Support	Mouse	Price
A13-KT 1	IBM 6x86 PR200+	AT	24X	PS/2 Mouse	\$479.99
A13-KT 6	AMD-K6 MMX 233MHz	ATX	24X	IntelliMouse	\$639.99
A13-KT 7	Pentium II MMX 233MHz	ATX	24X	IntelliMouse	\$829.99
A13-KT 8	Pentium II MMX 266MHz	ATX	32X	IntelliMouse	\$1,069.99
A13-KT 9	Pentium II MMX 300MHz	ATX	32X	IntelliMouse	\$1,269.99
A13-KT 91	Pentium II MMX 333MHz	ATX	32X	IntelliMouse	\$1,489.99

Add a Hard Drive and Memory. See right for specials.

Sorry but as prices are always changing on CPUs, we do not offer price protection in the event prices rise or fall. Ask for details and warranty information. Configurations & prices subject to change; ask your sales rep for latest configurations & prices.

3.2 GB Ultra DMA HD Incredible Priced At Just \$169⁹⁹!

ITEM #	CAPACITY	INTERFACE	SEEK TIME	TRANSFER RATE	SPINDLE SPEED	BUFFER	BAY SIZE	WARRANTY	PRICE
J34-1000	3.2 GB	Ultra DMA	11 msec	33 MB/S	5400 RPM	512KB	3.5"	3 years	\$169.99
J34-1002	4.3 GB	Ultra DMA	11 msec	33 MB/S	5400 RPM	512KB	3.5"	3 years	\$209.99

Western Digital Full Kit					Maxtor Full Kit				
ITEM #	CAPACITY	INTERFACE	SEEK TIME	PRICE	ITEM #	CAPACITY	INTERFACE	SEEK TIME	PRICE
W10-1136	3.1 GB	EIDE Mode 4	<12 msec	\$199.99*	M122-2005	4.3 GB	EIDE Mode 4	12 msec	\$229.99*
W10-1140	5.1 GB	Ultra DMA	<11 msec	\$249.99*	M122-2006	5.1 GB	EIDE Mode 4	10 msec	\$259.99*
W10-1142	6.4 GB	Ultra DMA	<9.5 msec	\$279.99*	M122-2010	8.4 GB	EIDE Mode 4	12 msec	\$399.99*

*Price after \$30 manufacturer's mail-in rebate.

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Abort, Retry, Fail?

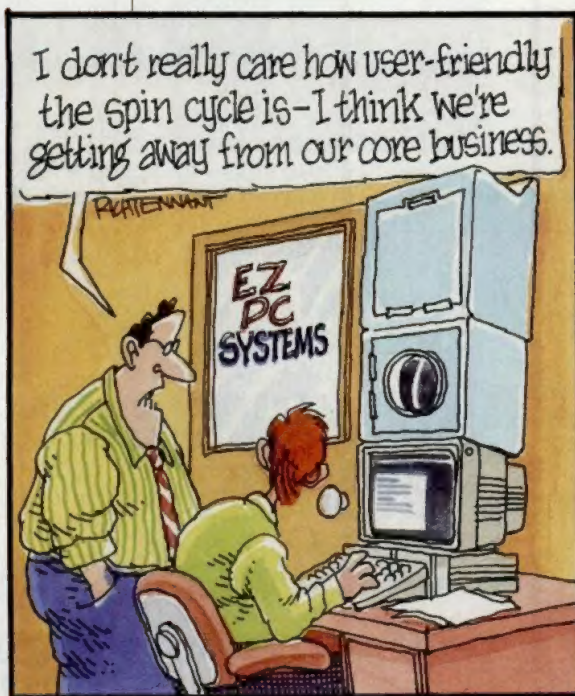


This virtual Spider helped an acrophobic patient at the HIT Lab overcome her fear of spiders.

And then they got to work on her fear of heights. (Computer Graphics World)

Yeah, Sometimes Math Can Be Difficult

"How much difference can the right programmer's editor make? Imagine you save just 3 seconds 50 times a day. You save 2.5 hours a day. Do that every day and you save 66 days a year."—CODEWRIGHT PROFESSIONAL AD



If your entry is used, we'll send you \$50 and a PC Magazine T-shirt. Send your entries to Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016-5802 or via e-mail to don_willmott@zd.com. Winners this issue: John Borg, Bill Buell, Michael Denning, Marty Marbach, J.D. Robinson, and Abby Rosenstein.

Which Side Do You Believe?

Package design can be a subtle art. One side of the box for Norton Utilities 3.0 says that "over 30 million customers have relied on us since the introduction of Norton Utilities." On the other side it says that there are "over 15 million satisfied users of Norton Utilities." Makes you wonder about the other 15 million.



A High-Tech "Change of Life"

This ZDNet brochure must have caught the attention of lots of middle-aged women: "NEWS NOW! Check ZDNN—#1 source for hot flashes on technology news."



Why is this man smiling? Because he just bought a Unicent Technologies PC (the ad on the right) or because he's taking a new prostate vitamin supplement (the ad on the left)?

That's one scary printer! (Lexington Herald-Leader.)

OUR INSPIRON NOTEBOOK HAS THE FASTEST MOBILE INTEL PROCESSOR ON EARTH.

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NEW DELL INSPIRON™ 3000 M266XT 266MHz PENTIUM® PROCESSOR WITH MMX™ TECHNOLOGY

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- ★ Inspiron Port Replicator, add \$159.

\$2999

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